PB-213 733

Odors and Air Pollution

a bibliography with abstracts

Environmental Protection Agency

OCTOBER 1972

Distributed By:

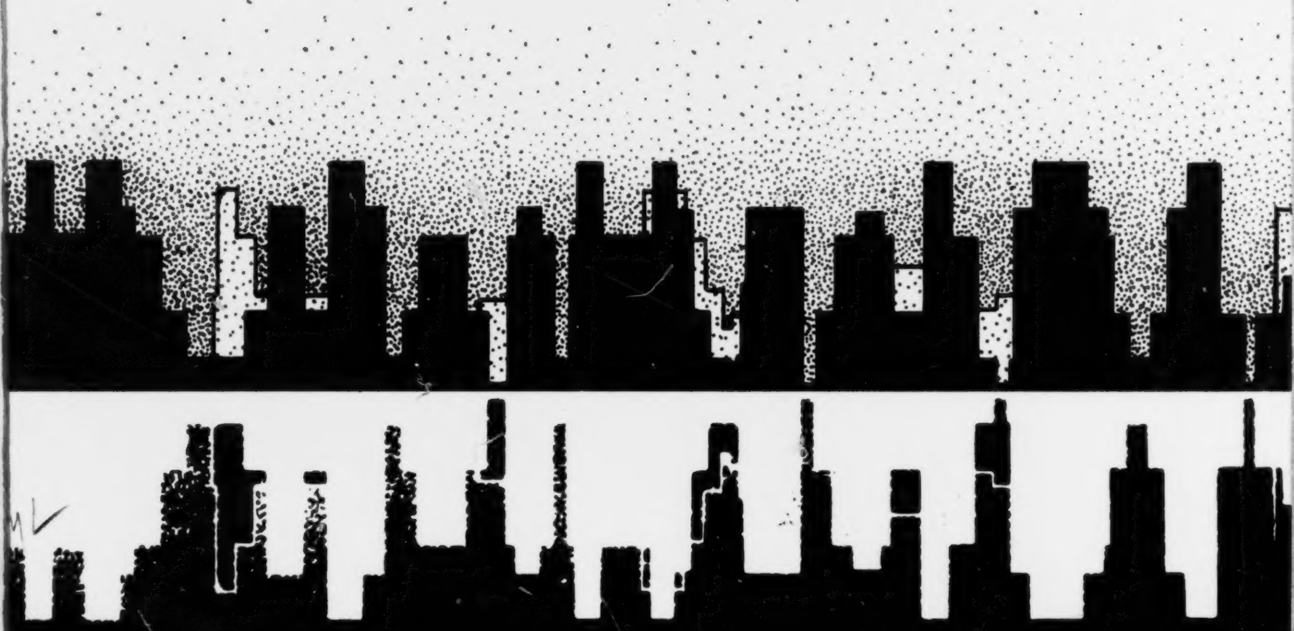
NTIS

National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

AP-113
PB 213 733

ODORS AND AIR POLLUTION:

A BIBLIOGRAPHY WITH ABSTRACTS



Reproduced by
NATIONAL TECHNICAL
INFORMATION SERVICE
U S Department of Commerce
Springfield VA 22151

U.S. ENVIRONMENTAL PROTECTION AGENCY

BIBLIOGRAPHIC DATA SHEET

1. Report No. AP-113

2.

3. Recipient's Accession No. PB-213733

4. Title and Subtitle
Odors and Air Pollution: A Bibliography with Abstracts

5. Report Date
October 1972

6.

7. Author(s)

8. Performing Organization Rept. No.

9. Performing Organization Name and Address
ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
Air Pollution Technical Information Center
Research Triangle Park, North Carolina 27711

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Address
Same

13. Type of Report & Period Covered

14.

15. Supplementary Notes

16. Abstracts

An annotated bibliography presents a compilation of abstracts which deal with odors as they relate to air pollution. The abstracts are arranged within the following categories: Emission sources; Control methods; Measurement methods; Air quality measurements; Atmospheric interaction; Basic science and technology; Effects-human health; Effects-plants and livestock; Effects-materials; Effects-economic; Standards and criteria; Legal and administrative; Social aspects; and General.

17. Key Words and Document Analysis. 17a. Descriptors

Air Pollution
Bibliographies
Odors
Emission
Sources
Air Pollution Control Equipment
Measurement
Criteria
Standards
Legislation
Sociology

17b. Identifiers/Open-Ended Terms
Air Pollution Control
Air Quality Measurement
Air Pollution Detection
Air Pollution Effects (animals)
Air Pollution Effects (plants)

17c. COSATI Field/Group 13B

18. Availability Statement
S.O.D. U.S. Government Printing Office
Washington, D. C. EP4:9-113

19. Security Class (This Report) UNCLASSIFIED

20. Security Class (This Page) UNCLASSIFIED

21. No. of Pages 263

22. Price NTIS $5.50

FORM NTIS-35 (REV. 3-72)

THIS FORM MAY BE REPRODUCED

USCOMM-DC 14952-P72

ODORS AND AIR POLLUTION:
A BIBLIOGRAPHY WITH ABSTRACTS

Air Pollution Technical
Information Center

ENVIRONMENTAL PROTECTION AGENCY
Office of Air Programs
Research Triangle Park, North Carolina
October 1972

Office of Air Programs Publication No. AP-113

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

CONTENTS

INTRODUCTION v

ANNOTATED BIBLIOGRAPHY

- A. Emission Sources 1
- B. Control Methods. 41
- C. Measurement Methods 129
- D. Air Quality Measurements 166
- E. Atmospheric Interaction 178
- F. Basic Science and Technology 180
- G. Effects - Human Health 186
- H. Effects - Plants and Livestock 192
- I. Effects - Materials 193
- J. Effects - Economic 194
- K. Standards and Criteria 195
- L. Legal and Administrative. 199
- M. Social Aspects 215
- N. General 219

AUTHOR INDEX 221

SUBJECT INDEX. 227

ODORS AND AIR POLLUTION: A BIBLIOGRAPHY WITH ABSTRACTS

INTRODUCTION

The Air Pollution Technical Information Center (APTIC) of the Office of Air Programs has selected and compiled this bibliography of abstracts on odors. The abstracted documents are thought to be representative of available literature, and no claim is made to all-inclusiveness.

The abstracts are arranged within the categories listed in the Contents. Within each category, they are arranged in ascending order by APTIC accession number. Generally, higher numbers, representing later accessions, have been assigned to more recent documents. Subject and author indexes refer to the abstracts by category letter and accession number. The author index lists all authors individually. Primary authorship is indicated by an asterisk (*).

All documents abstracted herein are currently on file at the Air Pollution Technical Information Center, Environmental Protection Agency, Research Triangle Park, North Carolina 27711. Readers outside the Environmental Protection Agency may seek duplicates of the documents directly from libraries, publishers, or authors.

Preceding page blank

A. EMISSION SOURCES

00393

A. T. Rossano, Jr. and R. R. Ott

THE RELATIONSHIP BETWEEN ODOR AND PARTICULATE MATTER IN DIESEL EXHAUST. Preprint. (Presented at the Annual Meeting Pacific Northwest International Section of the Air Pollution Control Association, Portland, Ore., Nov. 5-6, 1964.)

The odor emanating from diesel engine exhaust has become a more prominent nuisance within recent years. Past studies have been primarily based upon investigations of the chemical constituents in diesel exhaust. In this study, a thermal precipitator was used to collect the diesel soot. The use of this particular device prevented abnormal contact between the particulate and vapors or gas present in the diesel exhaust. 'Olfactometers' were used before and after soot collection to determine subjectively the intensity of odor in the diesel exhaust stream with and without the presence of the soot particles. The results of this investigation showed a significant reduction of the odor-causing substance through proper removal of the diesel exhaust soot particulates. Other correlative findings strongly suggest that the diesel exhaust soot is indeed the odor-carrier causing the electron microscopy studies showed that the soot particles were essentially nonuniformly distributed agglomerates of one micron diamter or less, in size. The basic elemental spheres forming the agglomerates were found to be approximately 400-500 Angstroms in diameter. Literature studies appear to support the premise that particles of this type can be effective carriers of gases and vapor. (Author)

00402

Horton, R. J. M. and R. O. McCaldin

OBSERVATIONS ON THE AIR POLLUTION ASPECTS OF IRAZU VOLCANO, COSTS RICA, - DECEMBER 8-16, 1963. Public Health Rept. (U. S.), no. 79:925-929, Oct. 1964.

Based on observations, examination of available data, and analyses of limited samples, it appears that the heavy ashfall resulting from the volcanic activity of Irazu, in Costa Rica, contained a substantial portion of respirable particles with a free silica content of about 1 percent. Sulfur gases were not measured but reports of taste and odor indicated that these were a minor factor in emissions. The ashfall causes redness and burning of the eyes, sore throat, and nasal irritation. Much of the pastureland was ruined. Cattle suffered intestinal disease from ingestion of ash. Large crews anf trucks were required to remove ash from San Jose plus constant cleaning indoors, and removal of ash from gutters and roofs to prevent their collapse.

00525

D. F. Adams

EUROPEAN AIR POLLUTION, 1964. J. Air Pollution Control Assoc. 15(8):375-379, Aug. 1965. (Presented at the Second Annual Meeting, Pacific Northwest International Section, Air Pollution Control Association, Portland, Oreg., Nov. 5-6, 1964.)

A study was made of the status of air pollution technology and research in Western Europe during the spring and summer of 1964. This report is based primarily upon information obtained by interview, visitation and observation at various industrial operations, governmental research laboratories, and communities. Various approaches to odor abatement are described. Vegetation damage from air pollution, and the community air pollution problem are discussed. Trends in research, standard sampling and analysis methods, and performance standards are reported. (Author's abstract)

01565

E. S. Starkman

ENGINE GENERATED AIR POLLUTION - A STUDY OF SOURCE AND SEVERITY. Preprint. (Presented at the Federal International Societes Ingeneures Techniques De L'Automobile, Germany, June 15, 1966.)

A brief comprehensive view of the state of knowledge, legislation, research and application of devices to control the influence of reciprocating engine emissions on man and his environment is presented from the viewpoint and experiences of a California observer. The pollutants considered are: unburned hydrocarbons; carbon monoxide; oxides of nitrogen; carcinogens; particulate matter; lead; odor; and oxides of sulfur. Engine operating modes and severity of emissions; engine factors and emissions; and legislative control of emissions are considered.

01644

I. B. Douglass and L. Price

A STUDY OF METHYL MERCAPTAN AND DIMETHYL SULFIDE FORMATION IN KRAFT PULPING. Tappi 49, (8) 335-42, Aug. 1966. (Presented at the 51st Annual Meeting, Technical Association of the Pulp and Paper Industry, New York City, Feb. 20-24, 1966.)

The formation of methyl mercaptan and dimethyl sulfide in kraft pulping has been studied with regard to the influence of wood type, temperature of cooking, sulfidity, and length of cooking. Digestions were carried out on a semimicro scale using, 1.0 g of wood and 4.0 ml of cooking liquor in a 7.5-ml stainless steel digester. Four types of wood, spruce, loblolly pine, red maple, and paper birch, were digested at 150, 160, 170, and 180C for 1,2,3, and 4 hr at 14.7,22.2 and 30.5% sulfidities. After completing each cook, the content of the digester was acidified to liberate methyl mercaptan and the amounts of organosulfur compounds formed were then determined by gas-liquid chromatography. Under comparable conditions, hardwoods produce more methyl mercaptan and dimethyl sulfide than softwoods. Cooks carried out at lower temperatures and for shorter times produce more mercaptan than sulfide but those carried out at higher temperatures and for longer periods, especially at high sulfidity, produce much more dimethyl sulfide than mercaptan. Curves prepared from the data clearly demonstrate that methyl mercaptan is the primary product and is consumed in the formation of dimethyl sulfide. Extrapolation of results obtained on this semimicro scale agree well with results reported from mill and pilot plant studies. (Author abstract)

01885

W. T. McKean, Jr., B. F. Hrutfiord, and K. V. Sarkanen

KINETIC ANALYSIS OF ODOR FORMATION IN THE KRAFT PULPING PROCESS I. Paper Trade J. 149, (35) 41-2. Aug. 30, 1965 and Tappi 48, (12) 699-704, Dec. 1965. (Presented at the National Meeting, American Inst. of Chemical Engineers, San Francisco, Calif., May 1965.)

The kinetics of the consecutive formation of methyl mercaptan and dimethyl sulfide at constant liquor composition were determined at several temperatures using a novel gas analysis based on vapor phase sampling. Comparison of kraft pulping of softwood and hardwood species shows that more organic sulfur compounds are produced from the latter group. In softwood pulping, a general enhancement in the reactivity of the lignin methoxyls occurs during the alkaline delignification process which results in accelerated odor formation during the last phase of pulping. The activation energies of these reactions suggest a substantial reduction in total formation of organic sulfur compounds may be accomplished by raising the reaction temperature and shortening the time of the kraft cook. The significance of the results to actual kraft pulping process is discussed. (Author abstract)

02001

B. Gills E.L. Howe

OIL BURNERS FOR DOMESTIC APPLICATION: PRESENT DESIGN AND FUTURE DEVELOPMENTS. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper III/2.) pp. 37-44.

Published work from various research organizations in Europe and the U.S.A. concerning malfunctioning of domestic pressure jet burners is reviewed. It is shown that when poor combustion performance of pressure jet burners is experienced the cause can be traced to one, or a combination of the following factors: 1. Poor design of the air/fuel mixing system. 2. Bad maintenance. 3. Bad matching of the burner characteristics to the heating appliance requirements. Bad performance of any combustion system is reflected in the composition of the final exhaust products. Results are presented which show that a combustion system can generally be operated so that it products no smoke, carbon monoxide or unburnt hydrocarbons. Due to attention which has recently been drawn to 'exhaust odor' from oil-fired appliances reference is made to methods of measuring the total hydrocarbon content of flue gases. Recent developments with the objective of impo developments with the objective of improving the combustion performance and reliability of domestic oil burners are described, together with references to research into methods of distillate fuel atomization and combustion using novel principles. (Author abstract modified)

02765

J.J. Schueneman C.G. Beard, II

CHARLESTON-KANAWHA VALLEY AIR POLLUTION STUDY - A DESCRIPTION. Preprint. (Presented at the 55th National Meeting, American Institute of Chemical Engineers, Houston, Tex., Feb. 7-11, 1965, Paper No. 46c.)

The Kanawha River Valley area around Charleston, West Virginia, contains one of the nation's largest concentrations of basic chemical production. The chemical processes and other industrial operations, along with substantial use of coal for fuel, have resulted in an air pollution problem. The situation is aggravated by meteorological conditions and a rugged terrain that hamper atmospheric dispersion of air pollutants. The West Virginia Air Pollution Commission and the United States Public Health Service, with many operators, have initiated a study that encompasses air quality, pollutant emissions, meteorology, effects of pollution on materials, odors, vegetation damage, and means of pollution control. The area being studied and past air pollution studies are described briefly. The organization, outline, and work plan of the present study are presented in summary form. (Author abstract)

03097

S. Duckworth

THE METEOROLOGICALLY SCHEDULED OPEN BURN. J. Air Pollution Control Assoc. 15, (3) 274-7, June 1965

The feasibiloty of open buring under selected meteorological conditions is discussed. Meteorological provisos and non-meteorological factors are enumerated. Topics discussed include: combustion, fuel moisture, fire hazard, forecasting, fallout and odor, and air pollution potential. A mathematical estimate of visibility reduction is described and evaluated. A procedure for estimating atmospheric ventilation is presented. The author concludes that most massive open firest result in adverse effects on either a local or areawide scale. Hence, the best meteorological decision possible is frequently one that minimizes one scale of effect at the expense of the other. (Author abstract)

03825

Harris, Elliott S.

PROBLEMS OF SPACECRAFT MATERIALS SELECTION AND TOXICOLOGICAL EVALUATION. In: Proceedings of the Conference on Atmospheric Contamination in Confined Spaces: 30 March - 1 April 1965, Aerospace Medical Research Lab., (6570th) Wright-Patterson AFB, Ohio, Contract AF 33(657)-11305, Proj. 6302, AMRL-TR-65-230, p. 231-241, Nov. 1965. 8 refs. CFSTI, DDC: 629622

Inhalation toxicity could result from the off-gassing of non-metallic materials within the confines of the habitable area of a spacecraft. The criteria used to ensure an innocuous atmosphere in the spacecraft have not been the same for each spacecraft manufacturer. The manufacturer of Gemini determines the acceptability of a non-metallic material by establishing the maximum temperature at which it is anticipated that it will be used. The acceptance limits are based upon 3 to 24 hours of continuous use tests in 100 percent 5 psia oxygen without producing irritating or obnoxious odors. The acceptability of non-metallic materials for the Apollo Command Module is based upon heating to 200 deg F in 100 percent oxygen at 5 psia for 48 hours. A gas sample is drawn off, passed through the gas chromatograph, and the total organic content of the vapors, as determined by a flame ionization detector, is expressed as pentane equivalents. Condensable materials are determined by evacuating the test chamber into a condensate trap and then returning non-condensables to the test chamber. The test chamber is brought to atmospheric pressure with oxygen and tested for odor by use of a Fair-Wells type olfactometer. The criteria are given for material to be considered acceptable. The test program for the qualification of the non-metallic materials used in the habitable area of the Lunar Excursion Module is similar to that used for the Command Module. The non-metallic materials are heated to 200 deg F for 72 hours in 100 percent 5 psia oxygen. The products that off-gas under these conditions are trapped, separated chromatographically, and identified by the combined or individual utilization of mass, ultraviolet and infrared spectroscopy. Odor evaluation is performed by subjecting the material to the conditions described previously. The gasses are brought to atmospheric pressure with oxygen and the odor is evaluated by a panel of 10 male non-smokers. Several factors are given which aid in minimizing the risk of a toxic response. The factors enumerated would insure that probability of contaminant buildups is quite low.

04785

D. A. Kendall and A. J. Neilson

ODOR PROFILE STUDIES OF EFFLUENT WASTE WATERS FROM SEVEN REFINERIES. Proc. Am. Petrol. Inst. 44, (Sec. 3) 62-7, 1964. (Presented before a Session on Controlling Refinery Wastes, 29th Midyear Meeting, American Petroleum Inst. Division of Refining, St. Louis, Mo., May 11, 1964.)

Currently odor measurement must rely on human sensory analysis as there are no instruments which have a comparable response or sensitivity. In many instances, chemical analyses and instrumental techniques can provide supporting information which is helpful in expanding, confirming, and interpreting subjective odor data. The human nose is an extremely convenient and useful instrument in providing both qualitative and quantitative information about odor, if, as is done by the odor profile method, adequate controls are exercised in presenting samples and in carrying out the analyses, and appropriate external reference standards are used. In profiling effluent wastes from a variety of refineries operating on various types of crude oil and with various treating facilities, in general, the effluents from the API gravity separator are quite similar in odor components, and in strength of odor generally fall within a range of a factor of 10 in threshold odor number. Each refinery appears to have specific odor characteristics by which it can be identified, as well as minor variations in the odor character from day to day or even hour to hour.

04860

R. T. Walsh

AIR POLLUTION ASPECTS OF THE INEDIBLE RENDERING INDUSTRY. J. Air Pollution Control Assoc. 17, (2) 94-7, Feb. 1967.

The fats rendering process; its air pollution aspects; quantitative odor measurements; sanitation; odor control methods including incineration, condensers, interceptors in vent lines, scrubbing, hoods and ventilation, carbon adsorption, masking agents and odor counteractants are reviewed.

04879

I. B. Douglass, and L. Price

SOURCES OF ODOR IN THE KRAFT PROCESS. II. SOME REACTIONS IN THE RECOVERY FURNACE. Preprint. (Presented before the Odor Abatement Session, 52nd Annual Meeting, Technical Association of the Pulp and Paper Industry, New York City, Feb. 22, 1967.)

In the recovery furnace concentrated black liquor loses its remaining water and the residual solids then undergo pyrolysis. One may assume that the black liquor solids consist of lignin- and carbohydrate- derived organics and various inorganic sulfur-containing substances such as sodium sulfate, sodium sulfite, sodium thiosulfate, sodium sulfide or elemental sulfur. One series of experiments was carried out in which soda lignin was heated at 600 degree C with each of the inorganic substances listed and a second series in which each was heated with glucose. Sodium sulfate and sodium sulfite produced negligible amounts of hydrogen sulfide. With the other substances, however, both soda lignin and glucose converted 30-75% of the inorganic sulfur to hydrogen sulfide. These results clearly indicate the air pollution problem which will develop if the recovery furnace is operated in such a manner that complete combustion of the hydrogen sulfide does not occur. (Author abstract)

04893

Douglas, I. B.

THE CHEMISTRY OF POLLUTANT FORMATION IN KRAFT PULPING. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: U. S. Public Health Service, National Council for Stream Improvement, and University of Florida. Deland, Fla., E. O. Painter Printing Co., ((1966)), p. 41-71. 14 refs.

The emission of malodorous compounds from the digester arises from a stripping of hydrogen sulfide and from the reaction of sulfide or hydrosulfide ions with the methoxyl groups present in lignin. Methyl mercaptan is the primary product of the reaction but it reacts, as the mercaptide ion, in a more rapid secondary reaction to produce dimethyl sulfide. Hardwoods produce more malodorous compounds than soft woods. High temperatures, high sulfidity and long reaction time all favor the production of the sulfur compounds. There may be some production of malodorous compounds during the process of evaporation but it is not yet clear whether this is primarily a stripping action or whether there is additional formation of methyl mercaptan and dimethyl sulfide. The biggest sources of odorous compounds are the direct evaporator and the recovery furnace. Black liquor oxidation will largely eliminate the problem of the direct evaporator. The recovery furnace, however, presents a more serious problem since it is often overloaded and when this occurs large quantities of hydrogen sulfide, methylated sulfur compounds and sulfur compounds with two- and three-carbon groups will be emitted. (Author's abstract)

05007

J. H. Ludwig

SEMINAR ON AIR POLLUTION BY MOTOR VEHICLES. Preprint. 1967. 54 pp.

The various facets of the vehicle pollution problem from the standpoint of both effects on community atmospheres nationwide and the source of variables are summarized. The problems that remain today encompass a number of considerations, which may be enumerated as follows: (1) The importance of the diesel problem as it relates to smoke and odor control, the means for securing reduction of smoke and odors, and the development of test procedures for the setting of standards; (2) The importance of relative reactivity of the various organic species, particularly hydrocarbons, and the effects of reactivity on both standards and control methods; (3) The importance of various emission sources (exhaust, crankcase ventilation, fuel tank evaporation and carburetor evaporation losses) in relation to reactivity and need for control and the development of test procedures for these sources from all types of vehicles (passenger cars, trucks and buses); (4) The need for control of nitrogen oxides from vehicular sources, both gasoline engine and diesel engine power sources and concurrently for stationary sources; (5) The importance of instrumentation in measurement of pollution parameters for research, enforcement (certification) procedures, surveillance and inspection; (6) The problems of maintenance of devices on vehicles to insure their continued operation (surveillance and inspection), and/or the upgrading of such devices such that they will be essentially maintenance free; and (8) The importance of in-traffic carbon monoxide levels, particularly their significance relative to driver fatigue.

05335

Schmidt, R. C., A. W. Carey and R. Kamo

EXHAUST CHARACTERISTICS OF THE AUTOMOTIVE DIESEL. In: Vehicle Emissions, Part II, SAE Progress in Technology Series, Vol. 12, Society of Automotive Engineers, Inc., N. Y., 1966, p. 394-401. 11 refs. (Presented at the SAE West Coast Meeting, Los Angeles, Calif., Aug. 8-11, 1966.)

The production of pollutants and an increasing need for pollution management are an inevitable concomitant of a society with a high standard of living. The automotive diesel engine is used more than any other type of engine for transporting freight over high- ways. Two kinds of pollution to be considered with regard to the diesel engine are the dark exhaust smoke and odor, of which the public is quite cognizant, and the less obvious but possible toxic carbon monoxide, oxides of nitrogen, unburned hydrocarbons, and trace compounds of other toxic materials. This paper discusses sampling, measurement techniques, and established standards for exhaust smoke and odor. Examination of diesel exhaust shows it to be less offensive in terms of harmful effects than the invisible exhaust from other types of engines. The major problem is exhaust color and odor. (Author abstract)

05527

Meyer, W. E.

CONTROLLING ODOR AND SMOKE FROM DIESEL EXHAUST. Proc. Sanitary Eng. Conf., Air Resources Planning Eng., Pittsburgh, Pa., 1965, pp. 41- 54.

To the public the distinguishing features of a diesel engine are its smoke and its odor. Neither has been proven to be connected with any direct or indirect effect of diesel exhaust on the health of man or beast, nor damage to plant life or property. Diesels do not emit significant amounts of either carbon monoxide or hydrocarbons. The only noxious emission of any consequence with which diesels can be charged are nitrogen oxides. Diesels can be built and adjusted not to smoke but this would mean accepting less output from a given engine. It has become customary in the indus- try to set the maximum engine output so that the exhaust smoke does not exceede No. 2 on the Ringelman chart. There is no way of preventing diesel smoke once and for all. It can be controlled and there are numerous devices, means, methods and procedures for controlling it. The real cure is, therefore, to legislate that diesels shall not emit smoke above a certain density and leave it to engine, accessory and fuel manufacturers, owner, operator and driver to decide among and for themselves how compliance with the law is to be obtained.

05549

Hochheiser, S., E.E. Lozano, and W. W. Melvin

AIR POLLUTION EMISSIONS FROM JET ENGINES. J. Air Pollution Control Assoc., 18(6):392-394, June 1968. 8 refs. (Presented at the 60th Annual Meeting, Air Pollution Control Associa- tion, Cleveland, Ohio, June 11-16, 1967, Paper 67-126.)

Pollution emissions from three representatives types of jet engines were determined. Pollutants measured included nitrogen oxides, aldehydes, carbon monoxide, hydrocarbons, and odors. A method is presented for determining the magnitude of pollution emissions due to commercial jet aircraft operation by using basic emission factors. These engines were: 1) the T-56 turboprop engine, 2) the J-57 conventional jet engine, and 3) the TF-33 fan-jet engine. Oxide of nitrogen emissions mainly take the form of nitric oxide. In TF-33 exhaust, the percent of nitric oxide in the total nigrogen oxides varied from 82 to 93; and in J-57 exhaust, the percent composition varied from 62 to 76 percent, de- pending upon engine power setting. Percent composition of nitric oxide was greatest at the 100 percent power setting and lowest at the 65 percent power setting. Photochemically reactive hydro- carbon content (olefins and aromatics) of T-56, J-57, and TF-33 exhaust represented 35, 51, and 40 percent, respectively, of the total hydrocarbons emitted at the 65 percent power setting. Ole- fin content was significantly greater than aromatic content in TF-33 exhaust. The principal aldehyde present in jet engine exhaust was formaldehyde. Carbon monoxide and hydrocarbon con- centrations in exhaust products generally varied inversely with engine power setting, and nitrogen oxide concentration generally varied directly with engine power setting. (Author abstract)

05608

C. E. Schumann and C. W. Gruber

MOTORIST EXPOSURES TO ALDEHYDES FROM DIESEL-POWERED BUSES. J. Air Pollution Control Assoc. 14, (2) 53-5, Feb. 1964. (Presented at the 56th Annual Meeting, Air Pollution Control Association, Detroit, Mich., June 9-13, 1963.)

A sampling survey of the amounts of aldehydes to which motorists are exposed while following diesel buses in the City of Cincinnati is reported. The data obtained from this survey, coupled with personal observations by the authors, indicate the following: (1) Motorist exposures to aldehydes (low molecular weight aldehydes, such as formaldehyde and acrolein) from diesel buses in Cincinnati are well below published maximum average atmospheric concentration of contaminants for industrial workers for 8-hr day exposures. However, this does not preclude, nor is it the intent of the authors to state, that exposure to such levels of aldehydes or related diesel exhaust products cannot produce adverse health effects, either directly or indirectly. Standards have not been established for general population exposures to community air pollution. (2) Of the 15 buses sampled, none could be classified as excessive 'smokers.' This could be attributed to several factors; e.g. the use of better quality fuels, and improved inspection and maintenance program, and a recent change in fuel injector tips to improve fuel atomization into the combustion chambers. (3) Aldehyde concentrations two or three car lengths behind buses can, and sometimes do, exceed the odor threshold of the lower aliphatic aldehydes. It has been estimated that the per gallon aldehyde losses from diesel fuel exceed that of gasoline by a factor of three. Based upon a four mile per gallon diesel fuel requirement for city bus operations compared to a 12 mile per gallon requirement for conventional automobiles, the diesel bus will emit nine times more aldehydes per mile traveled than the automobile. In spite of obvious improvements in visible smoke emissions, the diesel-bus odors in Cincinnati still exist in sufficient quantities to prompt public complaints. Whether future improvements or developments in fuel, engine design, maintenance, or control devices will result in an adequate reduction of offensive exhaust constituents to eliminate these public objections remains to be seen. (Author conclusions modified)

06039

K. J. Springer

INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE - PART 2 (MONTHLY PROGRESS REPT. NO. 4, APR. 15, - MAY 15, 1967). Southwest Research Inst., San Antonio, Tex., Vehicle Emissions Research Lab. (May 26, 1967) 12p.

Studies of the effect of engine derating on exhaust smoke and odor are in progress. The 6-month fleet test of a smoke suppressant additive, which began on April 1, is continuing.

A. EMISSION SOURCES

Preparations for the evaluation of the three types of catalytic mufflers for use with two-cycle powered buses are nearing completion. Preliminary studies are under way to establish the feasibility in the laboratory of relating an instrumental odor measurement method with the human odor panel.

06240

Y. Suzuki, K. Nishiyama, M. Oe, and F. Kametani

STUDIES ON THE PREVENTION OF PUBLIC NUISANCE BY THE EXHAUST GASES FROM THE KRAFT PULP MILL. (PART I. ANALYSIS OF EXHAUST GASES.) ((Tohoku J. Exp. Med. (Tokyo))) 11 (2), 120-6 (Aug. 1964). (Presented at the 37th Annual Meeting, Japan Society of Industrial Medicine, Kurume, Apr. 7, 1964.)

Exhaust gases of a Japanese kraft pulp mill were analyzed. The reported results were as follows: In the stack gases were contained: 0.259 g/cc of sodium sulfate, 750 ppm of hydrogen sulfide, 196 ppm of sulfur dioxide and organic compounds of sulfur. The organic sulfur compounds were as follows in order of amount: methyl mercaptan, dimethyl sulfide, isopropyl mercaptan, dimethyl disulfide, propyl mercaptan or ethyl methyl sulfide, diethyl sulfide and ethyl mercaptan. The amount of dimethyl sulfide was 8.7 ppm. Organic sulfur compounds in the gases in the upper part of the Jansson screen were of the same composition as those in the stack gases, but the arrangement of the constituents in order of amount are somewhat different. All of these gaseous sulfur compounds smell offensive and characterize the exhaust gases from a kraft pulp mill. (Author conclusion)

06981

06981 D. L. Brink, J. F. Thomas, K. H. Jones

MALODOROUS PRODUCTS FROM THE COMBUSTION OF KRAFT BLACK LIQUOR. III. A RATIONALE FOR CONTROLLING ODORS. Preprint. 1967.

In processing concentrated kraft black liquor the recovery furnace has been designed to carry out several unit operations and processes simultaneously but without specific control on the individual functions. A program of research is being conducted to isolate and study these functions independently in the laboratory. Conceptual designs are presented which are being studied with the objective of providing information that could result in improvements in recovery furnace operation. Such improvements could include greater control in operation -- particularly in combustion phases, improved startup and shutdown procedures, elimination of the hazard associated with smelt explosions, and minimizing emissions of malodorous products. The basis for the conceptual design has been provided through an investigation with particular emphasis on pyrolysis of black liquor solids--one of the critical furnace functions. Pyrolysis, studied previously by a batch technique and currently by a continuous steady state operation, has been shown to produce large volumes of highly combustible gases containing high percentages of the total sulfur in black liquor solids. The volatile sulfur compounds comprise a malodorous array with a composition that is highly temperature dependent. (Authors' abstract)

07089

Rosen, A.A., R. T. Skeel, and M. B. Ettinger

RELATIONSHIP OF RIVER WATER ODOR TO SPECIFIC ORGANIC CONTAMINANTS. J. Water Pollution Control Federation (Presented at the 35th Annual Meeting, Water Pollution Control Federation, Toronto, Canada, Oct. 7-11, 1962.) 35(6):777-782, June, 1963.

The results of odor tests conducted in conjunction with a study of organic contaminants in the Kanawha River at Nitro, West Virginia are reported. A major part of the odor of the river can be ascribed to 11 organic chemical compounds that were identified and measured. Naphthalene, Tetralin, Styrene, Acetophenone, Ethyl benzene, Bis(2-chloro-isopropyl) ether, 2-Ethyl hexanol, Bis(2-chloroethyl)ether, Di-isobutyl carbinol, Phenyl methyl carbinol and 2-Methyl-5-ethyl pyridine. Threshold odor concentrations for each of these compounds were determined from the responses of an odor panel. A mixture of all the identified pollutants, in the same proportions as found in the river, was shown to contribute nearly twice the amount of odor that can be calculated on the basis of the sum of the individual contributions. Thus, it was indicated that odor synergism plays its role as effectively in polluted streams as in the simulated instances tested in the laboratory.

07394

W. Pickel

QUANTITATIVE STUDY OF TOTAL EMISSIONS. (ANALYSIS OF EMISSIONS FROM COFFEE PRODUCTION.) Preprint, ((8)) p., July 31, 1966. 1 ref.

Fifteen companies prepare and roast approximately eighty three million pounds of green coffee beans in a year in the Chicago area. The process consists of (1) pre-cleaning green coffee beans to remove foreign matter, (2) blending various quality green beans for flavor, (3) roasting to chemically change the beans, (4) cleaning and cooling the beans to remove the heavy contaminants, and (5) grinding and packaging for consumption. With few exceptions, the only controll- device used for each of the first four operation si a cyclone which attempts to collect particulates, such as chaff, from the air strea. Results of the survey show that roasters emit an average of 330 pounds of chaff and dust per day while the cleaning operation discharges another 60 pounds to the atmosphere. Dense emissions from the roasting process contain smoke and odors which cyclically discharge from uncontrolled operations thereby constituting nuisance and other violations of most cities' air pollution codes. This project was instituted to determine total emissions entering the atmosphere from this industry. Only particulate emissions are considered at this time. (Author's summary, modified)

07561

Kaiser, E. R., J. Halitsky, M. B. Jacobs, and L. C. McCabe

PERFORMANCE OF A FLUE-FED INCINERATOR. J. Air Pollution Control Assoc., 9(2):85-91, Aug. 1959. 7 refs. (Presented at the 51st Annual Meeting, Air Pollution Control Assoc., Philadelphia, Pa., May 25-28, 1958.)

A limited survey of representative modes of operation and results of one flue-fed incinerator is reported. The tests were conducted to serve as a basis for comparison with fruture tests on identical incinerators with modifications to improve combustion and reduce air pollution. The incinerated refuse from a 128-apartment building was approximately 430 lb. a day. The flue-fed incinerator reduced the apartment refuse to about 37% of its original weight and to about 10% of its original volume. The bulk density of the refuse averaged 4.1 lb/cu ft. in the incinerator. The residue had a bulk density of 15.4 lb/cu ft. in the ash cans. The residue averaged 64% metal and glass, 12% ash, 16% combustible, and 8% moisture, excluding quench water. The air normally supplied to the furnace was 10 to 20 times the theoretical air necessary for complete combustion. The high excess air reduced the furnace temperatures and undoubtedly affected adversely the combustion of volatile matter and emission of fly ash. The infiltration air entering the flue through vents on the service doors and cracks averaged 35% more than entered the furnace. Sealing the vents reduced the infiltration air to the flue to 45% of the furnace air during the period of fast burning. The peak furnace temperatures varied from 970 to 1200 deg F. The emissions of particulate matter to the atmosphere via the flue gases ranged from 0.85 to 1.55% of the refuse weight. The weights of particulate matter ranged from 2.5 to 4.7 lb/1000 lb of furnace gas corrected to 12% CO2. The emission of eight noxious gases totaled 0.9 to 3.0 lb/100 lb refuse. The presence of additional unburned hydrocarbons in the flue gases was confirmed by mass-spectrometer tests. The average odor concentrations ranged from 2.5 to 100 ASTM odor units. The incinerator had inherent features of design and operation that caused high emissions of particulate matter and unburned organic compounds. The charging of refuse during burning could contribute to the discharge of particulate matter. Suggested modifications to the conventional incinerator include control of the furnace air supply, better mixing of air and volatile products from the burning refuse in a zone of high temperature, new furnace designs to eliminate the necessity for hooking and raking the refuse and residue, and residue removal with minimum air flow.

08359

Feuerstein, D. L., J. F. Thomas, and D. L. Brink

MALODOROUS PRODUCTS FROM THE COMBUSTION OF KRAFT BLACK LIQUOR. I. PYROLYSIS AND COMBUSTION ASPECTS. TAPPI, 50(6):258-262, June 1967. 7 refs. (Presented at the 51st Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 21-24, 1966.)

The production of malodors is an undesirable side effect that has always been associated with the kraft pulping process. Such malodors may originate at six major points in the overall digestion and combined recovery (inorganic chemical and heat) and organic waste elimination processes. Based on information in the literature, these points may be listed in order of decreasing contribution to atmospheric pollution: the recovery furnace is the major source, followed by evaporators, digester, lime kiln, oxidation tower, and dissolving tank. In the present study it was assumed that the recovery furnace operation covers a wide spectrum, such as distillation and sublimation, pyrolysis, auto-oxidation, stoichiometric combustion, and quenching. It was found possible to carry single charges of spent reaction liquors sequentially through the various steps in the laboratory under controlled conditions as well as to quantitatively collect and analyze all products. The contributions from individual, simultaneously occurring processes within a furnace are thus being considered for the first time from the standpoint of air pollution. Several unique control possibilities have been indicated as a result of this work. Results of the work relating to combustion techniques and sample collection are contained in this paper. Analytical methods and a discussion of the results obtained are presented in the second paper of this series. (Authors' abstract)

08373

Baum, Fritz and Wolfgang Steinbach

WASTE INCINERATION IN SMALL UNITS. Staub (English translation), 27(7):23-25, July 1967. 10 refs. CFSTI: TT 67-51408/7

The incinerator investigated has a triple jacket combustion chamber, and is heated up and charged with dry paper waste. The CO and CO2 concentration was recorded by infrared gas analyzers. During charging, CO concentration rose rapidly to 0.4-0.6 vol.% then dropped gradually. CO2 concentration rose rapidly to 1.0 - 1.5 vol. percent, then dropped slowly. The CO and CO2 concentrations were as a rule much lower than with medium units. Measurements to determine the emission of solids were performed with a Strohlein instrument at the chimney end. The results yielded a solid concentration between 300 and 425 mg/ cu m. Large quantities of hydrocarbons were deposited on the measuring filters apart from solids, which gave an impression of a deceptively high dust emission. The stong hydrocarbon development was confirmed by observations and measurements. For a long time white-gray clouds were emitted from the chimney, causing noxious odors in the vicinity.

08802

Hoffmann, H.

THE COMPOSITION OF EXHAUST GASES FROM DIESEL MOTORS. ((Die Zusammensetzung der Auspuffgase bei Dieselmotoren.)) Text in German. Z. Praeventivmed. Vol. 11, p. 104-121, March-April 1966.

The smoke emission of different types of diesel motors was determined and the results presented in a series of graphs. Under full load little difference in smoke emission was observed between chambered engines and direct injection engines, while the latter were superior under partial load. The various factors in engine development which influence smoke emissions are discussed. The carbon monoxide, aldehyde, and nitrogen oxide content of the exhaust gas was determined and it was found that the CO content is of no concern in diesel motors, since the concentration is not over 0.1-0.15 Vol.% and in many cases below 0.05 Vol.%. The same is true for aldehydes whose odorous annoyance has a psychological but not medical effect at the emitted concentrations. The nitrogen oxide content was found to be higher with direct fuel injection engines. The amount of 3,4-benzopyrene emission is influenced by the fuel composition and the combustion system and is only of concern if the motor is operated under high mean pressure, when as much as 0.5 gamma benzopyrene in 500 liters of exhaust gas was found at 1200-1500 U/min. under 3/4 load. It is concluded that by proper construction and development and particularly by proper care of the engine, the smoke from modern diesel engines can be reduced to an unobjectionable amount.

08912

Loquercio, Peter A. and William J. Stanley

AIR POLLUTION POTENTIAL FOR COFFEE ROASTING. Air Eng. 9(11): 22-26, 29, Nov. 1967.

Results of a study of the coffee roasting industry in Chicago's Emission Inventory Project revealed the identity of all the air pollution sources, the equipment associated with them, the type of pollutant emitted, their amounts and the frequency of emission. In the whole coffee process, excluding the preparation of instant coffee, air pollution is generated from 3 areas; (1) pre-cleaning of the green beans; (2) the coffee roaster; and, (3) the final cleaning of the roasted beans. The chief source was from the coffee roaster. Pollutants emitted from the entire process are dust and trash from the pre-cleaning phase; fumes, particulates and odors from the roasting operation; and chaff debris and resid- ual smoke from the final cleaning stage. To control emissions from the roaster, mechanical cyclone collectors are almost always employed. The particulate or chaff collected from the cyclone is conveyed into a special chaff incineratorwhich is serviced by an afterburner for the prevention of odor emissions. In order to comply with Chicago's strigent laws, the cyclone must be followed with another control device that will eliminate the fumes, tars, non-condensibles and odors discharging from the top of the unit. The only device that has proven successful in this function, as well as in eliminating odors from the chaff incinerator, is the cirect fired afterburner, properly designed to operate in a temperature range of 1200-1400 F. Several other approaches for control of these emissions from the roaster have been suggested to Chicago's Department of Air Pollution Control--(1) the cataly- tic afterburner, and (2) the scrubber utilizing potassium perman- ganate solutions or similar oxidizing agents. Upon completion of the survey of coffee roasting operations, it was found that they contribute approximately 50 tons annually to the city's atmos- phere.

09175

M. W. First, P. Zilles, J. Walkley

DISPOSAL OF LOW LEVEL RADIOACTIVE WASTE IN COMMERCIAL INCINERATORS. In: Proc. Ninth AEC Air Cleaning Conference, Boston, Mass., Sept. 13-16, 1966. James M Morgan, Jr. and Melvin W. First (eds.), Washington, D. C., Atomic Energy Commission, Vol. 1, Jan. 1967, p. 570-585. 7 refs. CFSTI: CONF 660904

A comparison was made of the performance of a crematory-type incinerator and a combination steam-boiler incinerator in the combustion of difficult laboratory and hospital wastes such as animals and cage litter. Because of excessive stack emissions of smoke, fly ash, and malodorous gases and vapors, the crematory-type proved unsatisfactory. Under the most favorable operating conditions for avoidance of air pollution and for production of a good quality residue, burning capacity was only 2 to 3 lbs/sq ft/hr. Higher burning rates produced severe nuisances. The mechanized steam-boiler incinerator, on the other hand, provided a sanitary method for handling and burning such wastes in an efficient and rapid manner. A cyclone dust collector proved superfluous for use with gas or oil fuels and it was found that it could be eliminated without decreasing the overall collection efficiency of an electrostatic precipitator which served as a final cleaning stage. (Authors' abstract)

09255

Styles, H. E., J. Vrebos, and P. J. 6awther

THE DIESEL ENGINE AND ATMOSPHERIC POLLUTION. World Health Organization Chronick (Geneva), 21(5):201-206, May 1967. 6 refs.

According to this review (based on report WHO/AP/67/28), the actual contribution of the diesel engine to air pollution is a relatively minor one and could be controlled with little difficulty and at small cost by appropriate selection of engine power and by the proper calibration, maintenance, and overhaul of fuel pumps and injectors. No excess of lung cancer or chronic bronchitis has been demonstrated in groups occupationally exposed to high levels of vehicular exhaust. A usual method of investigation is that involving detailed analysis of materials from engine exhausts under controlled, defined operating conditions. This method should be supplemented by accurate measurements of the levels of specific pollutants in the ambient air. Motor vehicle exhausts are regarded as very minor sources of atmospheric pollution compared with the inefficient combustion of coal. The odor of diesel exhausts is frequently objectionable, but the chemical nature of the offending substances is unknown. Diesel engines that emit needless amounts of smoke are either underpowered or overloaded, and in either case are being overfuelled.

09853

Walsh, Robert T., Karl D. Luedtke, and Lewis K. Smith

FISH CANNERIES AND FISH REDUCTION PLANTS. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 760-770, 1967. GPO: 806-614-30

There are two types of fish-canning operations in use today. In the older, so-called 'wet-fish' method, trimmed fish are cooked directly in the can. The more popular 'pre-cooked' process is used primarily to can tuna. The latter method is characterized by the cooking of whole, eviscerated fish, and the hand sorting of choice parts before canning. The main pollutants from fish and fish byproduct processing are odors. Control methods are discussed for such operations as digestion, drying, conveying, evaporating, and cooking.

10075

Williams, A. F.

OIL FIRING AND ODOUR PROBLEMS. (Due Olfeuerung im Hinblick auf Emissionsprobleme.) Text in German. Schweiz, Arch. Angew, Wiss. Tech. 31(4):105-112, April 1965. (presented at the S.V.M.T. Meetin Zurich, Switzerland, Sept. 11, 1964, Preprint in English.)

Smoke and smells are indicative of incomplete combustion. We propose to deal with underlying causes and curative measures which concern mainly the design and operation of the combustion appliance We shall discuss the various types of burners which are being used, particularly those which are prevalent in Switzerland for room and whole house heating. These are mainly pressure jet burners with so pot burners rated 15000 k cal/h. and above and operated on distillated gas oil. We shall comment on the relative merits of ON OFF and HIGH/LOW fire operation and quote test results for smoke an unburnt hydrocarbons produced by various burners during continuous firing or intermittent operation. Such unburnt hydrocarbons can gi rise to unpleasant odours. We shall show that a low smoke conditio is related primarily to good draught and an optimum excess air valu inside the fire box. Various new attempts to procude small, highly efficient atomizing burners will be mentioned. These include ultrasonic atomization and the Ventres blue flame, atomizing with vaporising burner. Lastly, in reference to typical Swiss oil quali and the standards set by SNV Institute, we shall give some results showing the influence of aromatic contem of the oil on its smoking propensity. Some mention will also be made about sulphur in the fu and SO2 emission from the chimney. (Author's summary, modified)

10699

Peterson, Carl M., Bruce Bruce F. McLouth, and Arthur J Roberts

RECOVERY OF PRECIOUS METALS BY INCINERATION OF EPOXY GLASS LAMINATES. Preprint, Minnesota Univ., Minneapolis Burn-Zol Inc., and Air Pollution Control Program, St. Paul, Minn., 12p., 1968. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968, Paper 68-185.)

Recovery of precious metals from electrical circuits printed on epoxy impregnated fiber glass laminates presents a difficult operation. Improper combustion of epoxy resin will produce a large amount of unburned hydrocarbons, soot, smoke and obnoxious odors. Furthermore, for recovery of gold and silver, the ash must be of proper consistency produced by burning at controlled tempera- ture. Many complaints were registered against a St. Paul Minnesota company whenever this recovery process was undertaken. Consequently, the company with the air of the city pollution con- trol agency enlisted a local incinerator manufacturer to determine the feasibility of modifying the existing incinerator or designing a special unit to meet emission requirements. After experimenta- tion it was found that the initial combustion temperature of the epoxy resin must be kept below 700 deg. F. to inhibit the soften- ing of the glass fibers which would prevent good separation of the metal. Afterburner temperatures of about 2000 deg.F. were needed to complete the combustion of the gaseous compounds and particu- lates in the waste gas. a vertical multi-chamber incinerator was designed with a gas burner in the combustion chamber and two addi- tional gas burners were provided in the afterburner chamber to ob- tain the necessary temperatures. An air inlet to the secondary chamber was needed to provide oxygen for complete combustion. Comparative tests conducted on the old and new incinerator in- dicated that a waste gas dust load reduction of about 83% was achieved with the new design. (Authors' abstract)

11144

Douglass, Irwin B.and Lawrence Price

SOURCES OF ODOR IN THE KRAFT PROCESS. II. REACTIONS FORMING HYDROGEN SULFIDE IN THE RECOVERY FURNACE. TAPPI, 51(10):465-467. Oct. 1968. 9 refs.

In the recovery furnace concentrated black liquor loses its remaining water and the residual solids then indergo pyrolysis. On may assume that the balck liquor solids consist of lignin- and car- bohydrate-derived organics and various inorganic sulfur containing substances such as sodium sulfate, sodium sulfite, sodium thiosulfate, sodium sulfide, or elemental sulfur. In two series of experiments, each of the inorganic substances listed was heated at 600 deg. C, first with soda lignin and then with glucose. In the experiments using sodium sulfate and sodium sulfite, negligible amounts of hydrogen sulfide were formed. In the experiments with elemental sulfur, sodium sulfide, and sodium thiosulfate, however, heating with soda lignin or glucose caused 30-75% of the inorganic sulfur to be converted to hydrogen sulfide. These results clearly indicate that in a recovery furnace large volumes of hydrogen sulfide are formed which, if the furnace is not operated properly may escape to the atmosphere and be a major cause of air pollution. (Authors' abstract)

11651T

Walter Hanstedt

PLANNING OF REFUSE ELIMINATION AND UTILIZATION PLANTS IN THE RUHR AREA WITH EMPHASIS ON MAINTAINING THE PURITY OF THE AIR. ((Planung von beseitigungs--und Verwertungsanlagen fur Mull im Ruhrgebiet im Hinblick auf die Reinhaltung der luft.)) Translated from German. Staub, 23(3):218-225, March 1963. 6 refs.

A working group comprising 22 townships was established in the German Ruhr area to develop and implement measures for refuse removal. Four possibilities of disposal are listed: the deposition of refuse in alternating layers with soil, composting of refuse, incineration combined with heat utilization, incineration without heat utilization. The advantages and disadvantages of these methods are discussed in detail, with special emphasis on air pollution by fly ash. Experience with a composting plant in Duisburg showed that for odor removal air coolers and scrubbers had to be installed. Finally a process was adopted which used chlorine dioxide for decomposing organic compounds. It is recommended that composting plants be located at least 500 m from residential areas. In refuse incineration it is shown that there is a difficulty in finding markets for the heat produced. An example of a large incineration plant with heat utilization in Karnap is given and it is emphasized that incinerators can be used in combination with peak power plants. Experience with a small incinerating plant without heat recovery is also described.

11692

Wessler, Max Alden

MASS SPECTROGRAPHIC ANALYSIS OF EXHAUST PRODUCTS FROM AN AIR ASPIRATING DIESEL FUEL BURNER. Purdue Univ., Lafayette, Ind., Dept. of Mechanical Engineering, Thesis (Ph.D), Ann Arbor, Univ. Microfilms, Inc., 1968, 126p. 20 refs.

Samples of exhaust from a laboratory diesel-fuel spray burner operating on cetane and air, or cetane and an artificial air where argon replaced nitrogen, were condensed in a series of cold traps. The exhaust vapors were analyzed by a mass spectrometer as the traps warmed to room temperature. In some tests, the exhaust was bubbled through a five percent aqueous sodium bicaronate solution to trap acids from the sample before they entered the cold traps. The basic solution assumed a strong yellow color in the standard-air test but was milky in appearance in the argon-air test. No other significant differences between the results from tests with the two kinds of air were observed, either from the standpoint of odor or the mass spectra. The color of the bubbler solution is apparently the result of nitrogen compounds in the exhaust. The work demonstrates, however, that nitrogen compounds are not significant contributors to the diesel odor problem. Evidence is presented for the presence in the exhaust of longer series of alkenes and alkynes in addition to lower aldehydes, including acrolein and a series of alkadienes. Ethylene oxide, propylene oxide, and benzene are identified, and there is good evidence for alkadiynes, dimethyl ether, and 1-buten-3-yne. The possibility of lower ketones, saturated and unsaturated cyclics, and heterocyclics is suggested. A group of peaks including mass-to-charge ratios 130,132, and 134 were present in all tests. No mass spectra data were found that would identify the compound that is the source for these peaks. (Author abstract modified)

11700

Alkire, H. L.

AIR POLLUTION IN SOMERSET COUNTY MARYLAND. Maryland State Department of Health, Baltimore, Div. of Air Quality Control, 12p., Nov. 1968. 8 refs.

Somerset County, Md., with a population of 19,300, is characterized by either flat or slightly undulating topography. Ninety percent of the county's area if 20 ft or less above sea level, and 12% of the county is water. The county's air pollution problems are intense in small local areas and are associated with odors generated by the processing of seafood and agricultural products. Though accepted by local residents without complaint, the odors should be controlled in the interest of air quality. The prospects of a significant increase in pollution due to industrialization appear to be slight in the foreseeable future. Despite the presence of light winds and a stable temperature lapse rate which tend to increase their concentration, pollutants are in general quickly dispersed by vertical air currents. Diffusion is good over long periods of time.

11969

TRASH INCINERATION PLANT FOR DARMSTADT. (Muellverbrennungsanlage fuer Darmstadt). Brennstoff-Waerme-Kraft, 16(8):408, Aug. 1964. Translated from German. 1p.

Two steel-tube boilers, each of 25 tons/hr steam capacity at 48 excess atm and 450 C are being furnished for a trash incineration plant for the city of Darmstadt. The trash incineration grates are designed for a trash throughput of 200 tons/day. The trash does not require preliminary pulverization or sorting. At about 1000 C incineration temperature, all possible putrefaction agents are destroyed; the ashes are therefore sterile and odorless. The dust is collected by filtering equipment to prevent pollution in the vicinity of the plant.

12083

Ewing, R. C.

REFINERY WASTE PRODUCTS POSE POLLUTION PROBLEM. Oil Gas J., 66(50):77-82, Dec. 9, 1968. 3 refs.

Oily waters and oil-soaked sludges are a major problem for petroleum refiners. Smoke and odors, usually attendant to plant upsets, also plague plant personnel and surrounding neighbors. The trends in refinery waste disposal are discussed. Where possible, chemical processes are used to convert plant wastes to salable materials. Fluidized-bed and ultrasonic incineration, biological processes, and deep-well disposal are among the disposal methods discussed.

12377

Millington, B. W.

THE NATURE AND CAUSE OF DIESEL EMISSIONS. Inst. of Mechanical Engineers, London (England), Automobile Div., Symp. Motor Vehicle Air Pollution Control, London, 1968, 5p. 16 refs. (Nov. 25-26, Paper 2.)

The combustion mechanism in a diesel engine differs somewhat from that in a gasoline engine, tending nearer to diffusion flame conditions than premixed flame, as a result of which a higher level of smoke appears in the exhaust. In order to keep the smoke emission within reasonable limits, the diesel engine is always operated at overall fuel/air ratios weak of stoichiometry; this probably contributes to the lower levels of other objectionable emissions such as carbon monoxide, unburned hydrocarbons, and oxides of nitrogen. Continued detail development of the combustion chamber geometry, air flow pattern, and fuel spray distribution should lead to reduced smoke emission, and possibly to reduced HC and CO at the same time. Oxides of nitrogen may be increased by these changes, but on the other hand, chamber configurations are known which materially reduce the NOX levels; chamber developments along these lines could be beneficial. Exhaust recirculation or retarded timing can help, but at a loss in thermal efficiency. Odor is associated with such poor combustion conditions as excessively weak zones in the mixture pattern or unduly late combustion. Appropriate engine development should improve the situation. Carcinogens are only produced in appreciable quantities under very poor combustion conditions; even then, there is little evidence that they are a hazard. Modification of fuel properties may assist in some measure to reduce emissions, but this route appears to have only limited possibilities. (Author conclusions modified)

12505

Marshall, W. F. and R. W. Hurn

FACTORS INFLUENCING DIESEL EMISSIONS. Preprint, Society of Automotive Engineers, Inc., New York, 12p., 1968. 6 refs. (Presented at the West Coast Meeting, Soc. Auto. Engrs., San Francisco, Calif., Aug. 12-15, 1968, Paper 680528.)

Smoke, odor, and other emissions of concern in environmental pollution from four diesel engines were studied experimentally. Engine design, operational mode, and fuel characteristics were considered as variable factors influencing the emissions. The engine included a turbocharged 4-cycle unit, normally aspirated 4-cycle units, and an air-scavenged 2-cycle engine. All were direct injection, truck-type power units. Fuel characteristics differed widely among eight fuels used in the study, with principal differences occurring in sulfur and aromatic content. Results of the experimental study showed that emissions levels in all categories are markedly influenced by engine operation. Within the group of engines tested, generally high emissions of unburned hydrocarbons are associated with the 2-cycle design, high smoke levels with the 4-cycle normally aspirated engines, and high emissions of NO(x) and oxygenates with the turbocharged 4-cycle engine. Exhaust odor intensity levels were roughly equivalent for all engine types. Emissions in all categories were surprisingly insensitive to variation in fuel characteristics, with the exception that smoke levels were significantly reduced with addition of a smoke suppressant additive to the fuel. Neither of two odor inhibitors was found effective. (Author abstract modified)

12507

Murray, F. E.

AIR POLLUTION FROM BIVALENT SULFUR COMPOUNDS IN THE PULP INDUSTRY. Preprint, Engineering Inst. of Canada, 16p., 1968. 10 refs. (Presented at the Banff Pollution Conference, Banff, Alberta, Can., March 1968.)

In the kraft process of producing chemical cellulose from wood chips, the chips are cooked in a solution containing sodium hydroxide and sodium sulfide in about a four-to-one proportion. This method produces much greater air pollution, in the form of highly malodorous compounds, than the alternative sulfite processes. The three primary sources of odor production in a kraft pulp mill are the digestion process, the direct-contact evaporator, and the recovery furnance. In the digestion process, control must be effected on the noncondensible gases from the digester and blow tank, from the multiple-effect evaporators, and on the foul condensates that are formed in contact with these gases. The emission of hydrogen sulfide from black liquor during direct contact evaporation can be very substantially reduced by oxidation of the sulfide. The problem of the recovery furnance is one of good operation and combustion control within the furnace design capacity. Present laboratory studies are expected to lead to continuing improvement in the control of odorous emission from kraft pulping operations.

12621

Benjamin, M., I. B. Douglass, G. A. Hansen, W. D. Major, A. J. Navarre, and H. J. Yarger

A GENERAL DESCRIPTION OF COMMERCIAL WOOD PULPING AND BLEACHING PROCESSES. TI-9 Pulp and Paper Committee. J. Air Pollution Control Assoc., 19(3):155-61, Mar. 1969.

The purpose of Informative Report No. 1, prepared by the TI-9 Pulp and Paper Committee of the air Pollution Control Association, is to present a general description of the commonly used processes for preparing and bleaching wood pulp. Further reports of a more specific nature will be published as these become available. (Author's Abstract)

12832

Alkire, H. L.

AIR POLLUTION IN CALVERT COUNTY, MARYLAND. Maryland State Dept. of Health, Baltimore, Div. of Air Quality Control. 22p., Aug. 1969 14 refs.

A survey of air pollution in Calvert County, Maryland is presented. The topography and meteorology of the area are described, and the aspects of land use, transportation, population, and fuel use are discussed. The only industry in this County which causes air pollution is associated with lumbering or the processing of wood products. The types of pollutants which are created are those which can be reasonably controlled. The amount of urban-type pollution is very small due to a relatively low population density and the lack of large urban areas. A nuclear power generating station under construction caused mixed public reaction. Unsatisfactory levels of dustfall and sulfation exist in the vicinity of a large electricity generating plant. The three county dumps often burn and cause unpleasant odors. The area has relatively good atmospheric ventilation which tends to disperse any pollutants emitted into the atmosphere. Recommendations for control and abatement procedures are given.

12834

Alkire, H. L.

AIR POLLUTION IN WORCESTER COUNTY MARYLAND. Maryland State Dept. of Health, Baltimore, Div. of Air Quality Control, 24p., July 1969. 19 refs.

A survey of the air pollution in Worcester County, Md., is presented. The topography and meteorology of the county are described, and the aspects of land use, population, transportation, and fuel usage are discussed. Specific air pollution problems are associated with poultry raising and processing, grain milling operations, fertilizer blending, mink farms, open dumps, and a plywood factory. The major pollutant from these sources is odor. Projected statistics indicate that the area will not have large urban types of pollution in the near future. Recommendations for control and abatement procedures are presented.

12998

EXHAUST PURIFIERS CLEAN THE AIR. Mater. Handling Eng., 24(8): 108-110, Aug. 1969.

Air inside Armstrong Rubber Company's West Haven, Conn. warehouse is kept clean by using a combination of exhaust blowers and LP gas lift trucks fitted with catalytic mufflers. Three blowers on each of the three storage floors are used to change interior air in the 600,000 sq ft building. The LP gas-fueled lift trucks are fitted with PTX purifiers. Platinum on a special ceramic support catalyzes the oxidation of the CO, hydrocarbons, and exhaust odors into CO2 and H2O vapor. The catalyst lasts thousands of hours without requiring replacement. The purifiers replace the conventional mufflers and work well with LP gas, white gasoline, or diesel fuel. They warm up in 30 to 45 sec. Zenith Corp. has equipped its seven tractors and 42 lift trucks with Oxy-Catalyst catalytic mufflers. These vehicles are fueled with 87 octane naptha gasoline. Exhaust gases are oxidized into CO2 and H2O as they pass through a bed of catalyst-coated pellets in the purifier. The mufflers require maintenance after 500 to 600 hrs of use. A 90 psi air stream is used to blow off carbon deposits and more pellets are added. After 2000 hrs of operation, the entire catalytic bed is replaced.

14116

Hurn, R. W.

AIR POLLUTION AND THE COMPRESSION-IGNITION ENGINE. Preprint. Combustion Institute, Pittsburgh, 14p., 1968. 9 refs. (Presented at The Combustion Inst. Twelfth International Symposium on Combustion, Poitiers Univ., France, July 14-20, 1968, Paper 61-7.)

The compression-ignition engine, popularly known as the diesel, is examined as a contributor to metropolitan air pollution. Smoke and odor are recognized as the primary targets of public objection to the diesel, and factors relevant to the smoke and odor problem are discussed. Problems of diesel smoke are seen as readily manageable, but a satisfactory solution to the diesel odor problem is not yet available. Other pollutants, e.g., unburned or partially burned hydrocarbons, oxides of nitrogen, and carbon monoxide, are significant products of diesel combustion. Of these, only nitrogen oxides and possibly the aldehydes are typically discharged in quantities that in equivalent volumes may exceed the quantities discharged by spark ignition reciprocating internal combustion engines. Features unique to the diesel combustion process are discussed as factors relevant to generation or avoidance of objectionable pollutants. The high temperatures and oxygen availability in diesel combustion are seen as serious impediments to satisfactory reduction of the yield of nitrogen oxides, but they are favorable in holding concentrations of pollutants in other categories to acceptable low levels. To compound this advantage, the diesel has advantages both in fuel economy and in higher heat value of diesel fuel compared with lighter fuels. Thus, it would appear that diesel power offers an excellent opportunity for continued and expanded application to meet increasingly stringent clean air requirements. (Author abstract modified)

14297

Hind, C. J.

CLEAN AIR AND THE DIESEL. Indian Eastern Engr. (Bombay), 111(2):77-79, Feb. 1969.

A defense of the diesel engine against criticism that it is a heavy contributor to air pollution is presented. Under ideal conditions if all gasoline engines were replaced by diesel engines, the emission of carbon monoxide, aldehydes, and nitrogen oxides would be reduced, carbon dioxide, hydrocarbons, and soot would be increased, and sulfur dioxide would be unchanged. Carbon dioxide is not seen as a health hazard, and hydrocarbons are not considered dangerous, as they are in parts of the U. S., because the other conditions necessary for the creation of photochemical smog, particularly climatic factors, are not present in the U.K. Carbon monoxide, possibly the emission most hazardous to health, would be reduced to almost negligible amounts. Sulfur dioxide would necessarily be kept to a minimum, since in diesel engines the sulfur content of the fuel is deliberately kept very low to reduce internal corrosion of engines. In addition, because the diesel engine is more efficient than the gasoline engine, the absolute quantity of fuel oil used would be reduced, thus lowering the total impurities discharged into the atmosphere. Efforts are underway to reduce the major pollutants from diesels: smoke (carbon) and odor (sulfur dioxide). Supercharging by making use of energy remaining in the exhaust gases to drive a turbine and compressor, is seen as one way of maintaining a satisfactory fuel/air ratio for smokeless operation and greater efficiency as fuel input is increased. Improvements in the combustion process are being investigated as an engineering goal and to reduce odorous emissions.

14580

Schoening, M. A. and R. H. Wright

INTENSITY OF THE ODOR RELEASE AT VARIOUS POINTS IN THE KRAFT PULPING PROCESS. TAPPI, 35(12):564-569, Dec. 1952. 6 refs.

The concentration of hydrogen sulfide and methyl mercaptans in various plant effluents were surveyed in a study of the problem of odor reduction in kraft processing. Speicies of wood cooked were western hemlock, Douglas-fir, and red cedar; each was cooked separately and the concentration of malodorous gas measured at the following points: digester relief and gas-off, blow gases, evaporator effluents, furnace gases, stack gases, green liquor tank vapors, and sewer outfall. Results indicated that a higher concentration of mercaptan, on occasion 100,000 micrograms per liter, is given off in the noncondensable gas from a fir cook than from a hemlock cook, a fact that may be due to the turpentine formed from fir. Blow tank vapors were clearly the major source of odor since no attempt was made to condense the stream in the digester discharge. The use of raw sulfur produced a two to threefold increase in the mercaptan concentration in noncondensable gases. Though the total volume of condensable and uncondensable gases released from the blow tank could not be measured, rough calculatio suggest that the loss of sulfur may have exceeded 20 lb per cook. Stack gases carried about one third as much odorous material as the noncondensable blow gases and at a much lower concentration. Neither furnace gases nor evaporator effluents constituted a high intensity source of odor.

14914

Marshall, W. F. and R. W. Hurn

FACTORS INFLUENCING DIESEL EMISSIONS. Preprint, Society of Automotive Engineers, Inc., New York, 12p., Aug. 1968. 6 refs. (Presented at the West Coast Meeting, Soc. Auto. Engrs., San Francisco, Calif., Aug. 12-15, 1968, Paper 680528.)

Smoke, odor, and other emissions of concern in environmental pollution from four diesel engines were studied experimentally. Engine design, operational mode, and fuel characteristics were considered as variable factors influencing the emissions. The engine included a turbocharged 4-cycle unit, normally aspirated 4-cycle units, and an air-scavenged 2-cycle engine. All were direct injection, truck-type power units. Fuel characteristics differed widely among eight fuels used in the study, with principal differences occurring in sulfur and aromatic content. Results of the experimental study showed that emissions levels in all categories are markedly influenced by engine operation. Within the group of engines tested, generally high emissions of unburned hydrocarbons are associated with the 2-cycle design, high smoke levels with the 4-cycle normally aspirated engines, and high emissions of NO(x) and oxygenates with the turbocharged 4-cycle engine. Exhaust odor intensity levels were roughly equivalent for all engine types. Emissions in all categories were surprisingly insensitive to variation in fuel characteristics, with the exception that smoke levels were significantly reduced with addition of a smoke suppressant additive to the fuel. Neither of two odor inhibitors was found effective. (Author abstract modified)

14972

Smith, David B. and David H. Scott

COMPREHENSIVE AIR POLLUTION CONTROL PLANT. PART ONE. DATA SUMMARY. AIR POLLUTION AND METEOROLOGY. David B. Smith Engineers, Inc., Gainesville, Fla., HUD Proj. FLA. P-65, 38p., July 1968. 23 refs. CFSTI: PB-184678

A background study of air pollution in Palm Beach County identifies and locates the county's major emission sources. Climatological and meteorological conditions which increase the severity of pollution are described. It was found that common air pollution complaints to the county involve commercial incineration in close proximity to residential areas, caused by careless operating procedures. Improperly operated, the 74 approved small commercial incinerators produce soot, fly ash, and smoke. Seven sugar mills and two major fossil-fuel electric generating plants emit significant quantities of smoke and related pollutants due to either improper operation, low grade plant fuel, or can field burning with uncontrolled emissions. Pratt & Whitney Aircraft emits atmospheric pollutants on an occasional short-term basis. Burning of junked automobile hulks and production of asphalt contributes to the emissions. Only in the Pahokee-Belle Glade area do dustfall measurements exceed a median residential-commercial threshold concentration of 14.4 tons/square mile/month under average conditions. All sampling points experience greater maximum dustfall concentrations except Royal Palm Beach. Dustfall concentrations in Riviera Beach, West Palm Beach, Palm Springs, Delray Beach, Boca Raton and the Pahokee-Belle Glade area exceed the standard concentrations for strictly residential areas. Salhaven, Cross State, Boca Raton Rubbish, Lake Park, Pahokee North, and Belle Glade solid waste disposal sites practice open burning of wastes. Uncontrolled burning at some of these sites greatly reduces night time visibility along major transportation arteries including the Sunshine State Parkway. (Author abstract modified)

15297

Little, Arthur D., Inc., Cambridge, Mass.

CHEMICAL IDENTIFICATION OF THE ODOR COMPONENTS IN DIESEL ENGINE EXHAUST. Contracts PH 22-68-20 and CD-13-64, Proj. CAPE-7, Final Report. 92p., July 1969.

As part of an on-going program to determine the relationship between chemical species in diesel exhaust and the intensity and character of the exhaust odor, techniques were developed to isolate and chemically characterize the species responsible for the smoky-burnt portion of total exhaust odor. The system developed: silica liquid column chromatography, followed by silicone and carbowax gas chromatography, and monitoring of the effluent compounds by odor as well as by instruments, demonstrates the variety of odor types and complexity of the chemical mixture of diesel exhaust. These techniques should be sufficient to permit identification, particularly with regard to the lower-boiling temperature fractions, by high resolution mass spectrometry of the materials responsible for the diesel exhaust odor. Once such identifications have been made, studies will be initiated to determine the influence of engine operating parameters and fuel types on the production of these odor species.

16058

AIR POLLUTION STUDY - MUSKEGON, MICHIGAN METROPOLITAN AREA. Preprint, Michigan Dept. of Public Health, Lansing, Div. of Occupational Health, 24p., 1964 (?). 1 ref.

An emission inventory type air pollution study was conducted in the Muskegon metropolitan area to collect data on the amounts and character of industrial contaminants. The type of process being conducted, production rates, fuel consumption, the nature of air cleaning equipment, and the total quantities of pollutants emitted were investigated. Seventy-three industrial establishments were found to emit gaseous and particulate contaminants amounting to 106 tons/day, excluding combustion products. Combustion of coal was a serious source of air pollution: eleven plants emitted a total of 417 tons/day of combustion products to the atmosphere. Combustion of natural gas accounted for the emission of 3.6 tons/day of contaminants. No estimates of pollution from domestic heating appliances and domestic and industrial open or incineration type burning were made. Motor vehicles were believed to account for the release of 20 tons/day of hydrocarbons into the atmosphere as compared to 38 tons/day from refineries and bulk fuel stations and 3.2 tons/day from engine testing. Excessive dust, dense brown metallic oxide plumes, dense black plumes, characteristic odors, and a light to dense haze were observed. Manifestations of economic loss included car surface damage, accelerated corrosion of other metallic surfaces, discoloration of buildings, and increased everyday housekeeping costs. However, climatology is generally beneficial in terms of dispersion and removal of pollutants in the area. Inversions are infrequent and short-lived. Proper application and use of cleaning equipment should eliminate much of the pollution emanating from industrial processing and industrial combustion sources. It is recommended that an air pollution control board be established and that emissions of solid particles, sulfur dioxide, smoke, hydrocarbon vapors, and open burning of refuse and leaves be regulated by law.

16135

Hashimoto, Michio and Masahiro Fujiwara

EFFECTS OF AUTOMOBILE EXHAUST GAS EMISSION ON AIR POLLUTION. (Jidoshahaikigasu no taikiosen eno eikyo). Text in Japanese. Jidosha Gijutsu (Automobile Eng.), 23(11):1151-1163, 1969. 25 refs.

In 1968, automobile production in Japan was almost 4,100,000 cars, a million more than produced in West Germany, and second only to the United State's production of 11,000,000 cars in the same year. While the United States, West Germany, France, England, and Italy show no annual increase, automobile production in Japan is increasing at an annual rate of 25-30%. If this rate is maintained, the approximate annual output should match that of the United Stated by 1974. It is difficult to imagine the extent of pollution by automobile engine exhaust when automobile production in a country approximately the area of California approximates that of the United States. Based on the results of measurements in several cities, the following aspects of pollution by automobile exhaust are discussed in detail: carbon monoxide emissions; dust fall including lead and pyrene; photochemical contaminations; hydrocarbon emissions; and odors. The toxicity of air pollutants for humans and vegetation is also examined. Although work on carbon monoxide began late in Japan, air quality criteria are now being formulated with respect to carbon monoxide. Air pollution from automobile exhaust is found to be increasing by approximately 10-15%. It is hoped that control policies will be in effect before automobile production reaches one car for every two individuals.

16494

Akamatsu, Isao, Hiroshi Kamishima, and Yutaka Kimura

DEODORIZATION OF EXHAUST GAS IN KRAFT PULPING. (PART I). ON THE FORMATION OF MALODOROUS COMPONENTS IN KRAFT PULPING. (Kurafuto- parupu seizo kotei haishutsu gasu no mushuka (1 ho): Jokai-chu ni okeru akushu-seibun no seisei ni tsuite). Text in Japanese. Kami-pa Gikyoshi (J. Japan Tech. Assoc. Pulp Paper Ind.), 22(8): 406-410, Aug. 1968. 3 refs.

The formation of malodorous substances, methy mercaptan (MMA) and dimethyl sulfide (DMS), in the process of kraft pulping was studied in two types of Japanese pulp woods: softwoods (red pine, cedar and Japanese cypress) and hardwoods (beech, poplar, cherry and pasania oak). Alkaline (Na2O) and sodium sulfide (NaS) were added to a 400 g dried pulpwood block in an electric autoclave and boiled for 5-1/2 hours at 185 C. Then 5 cc of exhaust gas (raw blow gas) was sent into the cyclone-separator (a cylinder with the diameter of 3 cm and the length of 18 cm) and analyzed for malodorous substances (MMA and DMS) by the use of Yanagimoto GCG-5DH type gas chromatograph. Larger amounts of MMA and DMS, especially MMA, were produced by pulping hardwoods than by pulping softwoods. In pulping the same wood type, the amount of malodorous substances was increased with the increase of cooking hour and temperature, and the concentration of NaS. The white lauan produced the same malodorous substances in quality and quantity as obtained in the pulping of Japanese hardwoods. When the pulping was performed by a batch system, the concentration of DMS was decreased to trace with the depression of pressure in the autoclave.

17198

Endo, Ryosaka

RESEARCH ON THE SOURCE OF ODOR DEVELOPMENT AND THE RESIDENTIAL REACTION IN HOKKAIDO. (Hokkaido ni okeru akushu no hasseigen to jumin hanno). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(4):209-220, April 15, 1968. 23 refs.

The results of an empirical field survey of odor sources are presented. Residents of Hokkaido were sent olfactory test questionnaires and asked to identify the source of an odor, its degree, and its variation with time and season. The residents lived in an area of fish processing plants, oil and fat works, excrement-disposal facilities, paper mills, crematories, incineration plants, refuse dumping sites, and fox-breeding kennels. The returns, which amounted to 1,023,348 identifications of an odor source, were centered on fish- processing plants. This means that they are the major source of an odor problem affecting an estimated 218,300 persons. Next in order of importance were paper factories, incineration plants, agricultural processing plants, and animal breeding buildings. Of the fish-processing plants, the most offensive and noxious odor was produced by fertilizer made from fish flesh, fish oil, and other fish refuse. The major odors were generated in gas emissions from boiling and drying operations. Following the olfaction survey, the quantitative odor measurements and chemical analysis of odor components were undertaken in fishery fertilizer-processing plants. Volatile organic acid was observed to occupy the greatest proportion of offensive odors of fish fertilizers followed by ammonia, amines, mercaptans, and sulfurous acid.

17236

Nakamura, Naohiko

UTILIZATION OF REFUSE COMPOST. (Konposuto no riyo). Text in Japanese. Shigen (Resources), no. 175:19-21, Dec. 5, 1969.

Two potential merits of refuse compost are discussed. Refuse compost improves humus more effectively than conventional compost of which the dominant components are ricestraw rubbish and other refuse common to farming. From an eight-year investigation of the effect of refuse compost fertilization on vegetation, it was determined that the remaining rate of humus soil in an underground refuse compost is higher than that in ricestraw compost. Refuse compost is appropriate for soil deficient in organic matter or in B, Mn, Mo, and Zn, since it is enriched in these minerals after being composited in many different types of soil. In addition, refuse compost generally contains a considerable amount of lime, which makes it suitable for reforming the acid soil in Japan. In spite of these advantages, the use of refuse compost is not widespread in Japan, partly because its benefits are not understood and also because city refuse treatment facilities are directed toward incineration. As a consequence, the prevailing method of refuse treatment results in compost which is not sufficiently fermented, often odorous, or injurious to vegetation when utilized for soil improvement or farming. Refuse compost can be also applied to green zones in cities and used for many other purposes if it is of enriched quality. Results of laboratory research on the effect of refuse compost application on eggplant, tomatoes, cucumbers, and cabbages are reported.

17462

Murakami, M., T. Kawashima, and K. Kamitsu

INCINERATION PLANT AT ISOGO IN YOKOHAMA CITY. (Yokohamashi seisokyoku isogo kojo ni tsuite). Text in Japanese. Kukichowa Eisei Kogaku (J. Japan Soc. of Heating Air Conditioning Sanitary Engrs.), 44(2):131-138, 1970.

The design and operation of the recently constructed Isogo incineration plant is presented. The plant site area covers 13141 sq m, of which buildings occupy 7330 sq m. The plant is composed of three basements, five floors, a waste dumping building, a charging building, furnace building, central building, and other adjoining buildings. The average yearly incineration capacity is 300 t/24 hrs; the maximum capacity of 450 t/24 hrs is designed to meet seasonal increases in refuse. The plant is characterized by a sanitary working environment and the application of modern technology. The quantity of smoke dust emitted is less than 0.1 g/cu Nm due to the use of multicyclone and electric dust collectors. Effective smoke dispersion is promoted by a chimney height of 85 m; emission speed is more than 20 m/s. An airtight pit chamber prevents the discharge of odors. Waste water is chemically treated to meet water quality standards. At night, noise is suppressed to less than 50 phon. Furnace operations are automated and, like other proceedings, observed on television sets in a control room. Furnace rooms are ventilated 20 times/hr and other rooms between 10 and 15 times/hr. Surplus steam from waste heat in boilers is utilized for a sludge digestion tank and surplus gas, mainly methane, as a subsidiary fuel. The first floor of the plant is 5 m higher than the average tide level of Tokyo Bay.

17603

Miner, Sydney

PRELIMINARY AIR POLLUTION SURVEY OF HYDROGEN SULFIDE. A LITERATURE REVIEW. Litton Systems, Inc., Silver Spring, Md., Environmental Systems Div., Contract PH 22-68-25, NAPCA Pub. APTD 69-37, 91p., Oct. 1969. 148 refs. CFSTI: PB 188068

The literature on effects, sources, abatement, economics, and methods of analysis of atmospheric hydrogen sulfide is reviewed, with an appendix of tabular material from selected references. Hydrogen sulfide gas is very toxic to humans and at concentrations over 1,000,000 micrograms/cu m, quickly causes death by paralysis of the respiratory tract. At lower concentrations, it has an obnoxious odor and causes conjunctivitis with reddening and lachrymal secretion, respiratory tract irritation, pulmonary edema, damage to heart muscle, psychic changes, disturbed equilibrium, nerve paralysis, spasms, unconsciousness, and circulatory collapse. It also tarnishes silver and copper and combines with heavy metals in paints to discolor or darken the paint surface. The primary natural sources of H2S is biological decay of protein material in stagnant water. Among the many industrial sources are kraft paper mills, oil refineries, natural gas plants, and chemical plants, as well as sewage and sewage disposal plants. Average concentrations of H2S in urban atmospheres range from 1-92 micrograms/cu m. Emissions can be controlled by black liquor oxidation systems, scrubbers, and incineration devices. Hydrogen sulfide corrosion of silver has required substitution of gold contacts in electrical appliances at an estimated increased cost of $14.8 million during 1963. Abatement of air pollution from the pulp and paper industry, in which H2S is a major factor, has cost approximately $10 million per year and is predicted to increase. Major expenditures have been made by refineries and natural gas plants to remove H2S from sour gases and to recover sulfur as a valuable byproduct. Analytical techniques based on the methylene blue and molybdenum blue methods are available for laboratory analysis of H2S. The spot method, based on tiles or paper impregnated with lead acetate, is also widely used. (Author abstrac modified)

17631

Endo, Ryosaku, Tetsutaro Kogo, Tatsunori Oyake, and Hiroshi Hirakawa

OFFENSIVE ODORS. 10. INVESTIGATION OF THE EXISTING CONDITIONS IN HOKKAIDO WITH RESPECT TO OFFENSIVE ODORS (SECOND REPORT). CHEMICAL ANALYSIS OF THE COMPONENTS OF THE ODORS. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 4p.

An investigation of offensive odor constituents by chemical analysis was conducted at various marine processing plants. The waste gases from the exsiccation flue and vapor from the steam boiling process were collected and analyzed. The results were as follows: ammoniacal nitrogen, 4.13 g/l; volatile aminonitrogen, 3.8 g/l; volatile organic acid, 19.53 g/l; hydrogen sulfide, 0.35 g/l; and mercaptans, 0.95 g/l. The concentrations perceived by the sense of smell were different than these for each constituent. If the average or maximum value of the volume of each constituent is evaluated from the offensive odor threshold concentration, volatile organic acid would be greatest in volume perceivable by smell. Second would be mercaptans, then H2S, and ammonia which is actually the second most abundant. This may account for many of the difficulties involved in the evaluation of offensive odor components, their disposal, and countermeasures for them. In all cases, there was a relationship between freshness of materials and the degree of odor. The degree of freshness was especially low in the plants where mercaptans were abundant. Therefore, mercaptans may be regarded as an indicator in the method for evaluating offensive odors.

17632

Sone, Hikaru, Tetsuo Takijima, Shinsaku Sato, and Itaru Kikuchi

OFFENSIVE ODORS. 11. OFFENSIVE ODORS FROM MARINE PRODUCTS PROCESSING PLANTS. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 3p.

The offensive odors from 28 marine products processing plants were measured, using the saline solution equilibration method. Odor specimens were drawn off from the chimney flue with a vacuum pump into a 1% saline solution until saturated. The solution was then diluted to determine the odor concentration by the dilution multiple. It was found that 60% of the plants exceeded the standard limit set for public hazards. The maximum value was 2500. The odor concentration was high for sharks and for fish entrails which had lain for several days. Six different types of plants were selected as test plants in Ishinomaki City to determine the efficiency of deordorizing equipment. The rate of elimination of offensive odor was 80-90%, and the odor concentrations were reduced to below 300. The efficiency was even greater when a large amount of water was used.

17633

Kikuchi, Itaru, Shinsaku Sato, Hiroshi Funaki, and Hikaru Sone

OFFENSIVE ODORS. 12. AIR POLLUTANTS GENERATED AT KP PLANTS. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 2p.

Measuring operations were conducted at several kraft pulping plants to determine the source of pollutants, especially the offensive odors. Measurements were made of the exhaust gases from the heavy oil boilers, the recovery boiler, and the turpentine condenser. The JIS method was used to measure sulfur oxides, and the MB method for hydrogen sulfide. With respect to offensive odors, efforts were concentrated on the measurement of volatile organic sulfur compounds, such as methylmercaptan and methylsulfide; for this purpose, gas chromatography was used. The results showed that the sulfur oxides were within the prefectural limit for public hazards. It was confirmed, however, that an excessive amount of fine dust is generated from the recovery boilers and bark boilers. Also, H2S amounting to 60 ppm was detected from the recovery boilers. Substantial amounts of methylmercaptan and methylsulfide were detected from the turpentine condensers and from the recovery boilers. These compounds were identified and quantitatively determined. Some peaks not yet identified were also obtained in the gas chromatograms.

17634

Fujii, Toru

OFFENSIVE ODORS. 13. CONSTITUENTS OF, AND COUNTERMEASURES FOR, THE ODORIFEROUS FUMES FROM VINYL CHLORIDE 'LEATHER' FACTORIES. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 1p.

In vinyl chloride 'leather' manufacturing, a large amount of waste gas with an offensive odor is evolved in the effervescence treatment process. The constituents of the gas and a method for its disposal were investigated. When the gas was directly drawn off into distilled water, a decrease in the pH of the water was noted. The aqueous solution in which the gas has been absorbed contained NH4(+) and Cl(-). The eluate from extraction with benzene has a large amount of phthalic acid. These components were regarded as the substances which cause the offensive odor. They could be satisfactorily eliminated by using a venturi scrubber.

19366

American Foundrymen's Society, Des Plaines, Ill.

AIR CLEANING EQUIPMENT. In: Foundry Air Pollution Control Manual. 2nd ed., 1967, Chapt. 7, p. 33-56.

The basic types of industrial gas cleaning equipment are mechanical or inertial collectors, electrostatic precipitators, wet scrubbers, and fabric filters or bag collectors. Detailed information is given on characteristics and structure, selection criteria, advantages and disadvantages, operation, and maintenance for each of these. Operation and maintenance of catalytic combustion systems for odor control are also discussed. The efficiency, pressure drop variations, and temperature limits of various types of dust collecting equipment are considered, as well as the types and selection criteria for the fan components of these systems. Tables of collector efficiency and usual collector selection for foundry operations are included. Approximate equipment costs are briefly discussed.

19814

Rasmussen, Reinhold A.

ISOPRENE: IDENTIFIED AS A FOREST-TYPE EMISSION TO THE ATMOSPHERE. Environ. Sci. Technol., 4(8):667-671, Aug. 1970. 26 refs. (Presented at the American Chemical Society 157th National Meeting, Division of Water, Air, and Waste Chemistry, Minneapolis, Minn. 1969.)

Direct gas chromatographic, infrared, and mass spectrometric analyses of the air in contact with the plant foliage for five common tree species confirm previous observations of the existence of isoprene as a plant product. The foliages studies were on intact plants in leaf assimilation chambers under static conditions. Light quality was a mixture of Gro-Lux, cool white fluorescent tubes, and incandescent bulbs. The light intensity was 1100 ft candella and the temperature was 28 C; relative humidity reached 92% in the closed chamber within 10 min. Increasing concentration of the foliage-released volatile organic (isoprene) was monitored using 1-ml gas samples injected into the gas chromatograph. When the concentration of isoprene in the chamber reached 15-20 ppm, 1 liter of air in the chamber was transferred by a syringe pump to a saran plastic gas sampling bag which was usually analyzed by infrared and mass spectroscopy within four hours after collection. The presence of isoprene as indicated by gas chromatographic retention time data was observed in more than 30% of the 230 plant species surveyed. Nonaromatic foliages of oaks, willows, aspens, cottonwoods, and plane-trees released only isoprene in any appreciable quantity. When a group of 16 people in the laboratory was asked to smell these accumulated foliage isoprene volatiles from the nonaromatic leaves, the description given most often was 'smells like an oak forest,' whereas the response for smelling nonisoprene releasing foliages like maples, ash, birches, and alders was 'smells like fresh leaves.' Analysis of the air in contact with conifer foliages showed that only the genus Picea (spruce) released isoprene as a foliage volatile. Emanations of isoprene from the spruce needles did not respond to short-term fluctuations in transpiration. Mass spectra of isoprene and the foliage volatile were identical with a parent ion having a mass to charge ratio (m/e) of 68, representing the molecular weight of isoprene and a base peak of m/e 67 formed by the loss of a single H atom. Other prominent peaks were m/e of 53 from the loss of a methyl group and m/e of 39 which is the possible cyclopropene ring from skeletal rearrangement. Isoprene was also resolved directly from the out-of-doors air over mango foliages in Panama at concentrations of 0.5 to 24 ppb in 5 ml of air. The biological and air chemistry fates of isoprene are discussed. The fate of alpha-pinene and isoprene in the atmosphere may be similar to that of olefins from automobile exhaust; these studies suggest that naturally occurring organic volatiles are disposed of in a biological sink. (Author abstract modified)

19899

Sawaya, Tsugio

SURVEY ON THE PUBLIC NUISANCE BY OFFENSIVE ODOR. (Akushu kogai gairon). Text in Japanese. Kuki Seijo (Clean Air - J. Japan Air Cleaning Assoc., Tokyo), 8(2):34-46, June 1970. 12 refs.

Offensive odor as a public nuisance can be classified according to its composition in the following industrial sources: hydrocarbons and mercaptan from petroleum refining; organic sulfur compounds such as mercaptan from paper and pulp factories; and amine and fatty acids from fish meal and rendering factories and stockyards. Odors of each category are explained. While it is well established that olfactory reception is caused by a stimulus given to nerves by gaseous substances or air-borne particulates, the mechanism of the stimulus is not yet known. Odors of industrial waste water are classified into the following, that is, aromatic, free chlorine, disagreeable, earthy, fishy, grassy, moldy, musty, peaty, sweet, free hydrogen sulfide, and vegetable. Weber-Fechner's law, fatique, personal differences, and interference of odors are described. Definitions of threshold and odor concentration are provided. Measuring methods of odor include dilution by air, equilibrium with salt water, and a method used by processing factories to monitor the total amount of odor substances. Physical or chemical methods are available for odor abatement. Scrubbers, condensation by cooling, adsorption by active carbon, and dilution by air are in the physical category, while chemical methods include processing by acid, alkali, chlorine, or ozone, ion exchange, masking, recombustion, and catalytic combustion.

20101

Perez, J. M. and E. W. Landen

EXHAUST EMISSION CHARACTERISTICS OF PRECOMBUSTION CHAMBER ENGINES. SAE (Soc. Automotive Engrs.) Trans., 77(2):1516-1533, 1969. 10 refs. (Paper 680421.)

The differences between diesel engine combustion systems were demonstrated by comparison of precombustion chamber and experimental direct injection engines; emission measurements were made on total hydrocarbons, nitrogen oxides, carbon monoxide, carbon dioxide, and smoke. The mobile hydrocarbon analyzer employed was a modified commercially available gas chromatograph containing a hydrogen flame ionization detector. A sample of exhaust gas was drawn from a probe in the exhaust stack through a heated inlet line and a heated oven compartment by an oil-less vane type pump, and it was split 35:1 by use of suitable tubing in the discharge line from the pump. The smaller portion of the sample flowed to the hydrogen flame detector while the bulk of the gas stream exited through a static head water bubbler that served as a constant pressure line. The precombustion chamber was significantly lower in emissions, but odors from both the precombustion chamber and the direct injection systems were similar when both engines burned the same fuel. The total weight of exhausted hydrocarbons per 1000 gal of fuel measured from a precombustion chamber type engine, as used in highway truck applications, was about 10% of the current automotive standard. Odor intensity was about 20-30% of that from the direct injection engine, based on volume concentration of a sensory reference odor, and the oxides of nitrogen were appreciably lower in the exhaust of precombustion chamber engines.

20118

Barnes, Gerald J.

RELATION OF LEAN COMBUSTION LIMITS IN DIESEL ENGINES TO EXHAUST ODOR INTENSITY. SAE (Soc. Automotive Engrs.) Trans., 77(3):1706- 1725, 1969. 19 refs. (Paper 680445.)

Exhaust gas odor threshold dilution ratios were determined by a single panelist using the Sniff-Mask technique during idle operation of a single-cylinder 4-stroke cycle diese engine using n-heptane as a fuel; the effect of various changes in the intake atmosphere composition on odor thresholds was determined. The substitutions of argon and helium for the nitrogen in the normal intake air produced a 15-fold reduction in the exhaust odor thresholds, while the substitution of carbon dioxide increased the odor threshold by a factor of 4. Changes in the intake atmosphere composition altered the diffusional mixing processes, the fuel spray patterns, the compression and combustion temperatures, and the combustion limits within the combustion chamber. A good correlation was found between the measured exhaust odor thresholds and the lean flammability limits of pre-mixed flames determined in the intake atmospheres used, suggesting that diesel odor is caused by odorous products of partial oxidation that are produced in regions of fuel/oxidizer mixtures too lean to burn at the start of combustion. (Author abstract modified)

20125

Lienesch, John H. and Wallace R. Wade

STIRLING ENGINE PROGRESS REPORT: SMOKE, ODOR, NOISE AND EXHAUST EMISSIONS. SAE (Soc. Automotive Engrs.) Trans., 77(1):292-307, 1969. 17 refs. (Paper 680081.)

The Stirling engine is a closed cycle external combustion engine that differs from most heat engines in that energy is added to and withdrawn from the working fluid through two multitube heat exchangers, i.e., the heater and the cooler. Thermal energy can be supplied to the heater from practically any high-temperature source. Measurements made on a 10 hp single cylinder engine operating on diesel fuels indicate that it is unobjectionable with regard to smoke, odor, and noise. No smoke was detected at engine speeds of 3000 rpm at idle half-load, or full load. Exhaust odor was undetectable at concentrations normally encountered in the atmosphere. When observed at 100 ft, the Stirling unit was 21 dB quieter than a standard internal combustion unit. The levels of unburned hydrocarbons and carbon monoxide in Stirling engine exhaust are two orders of magnitude less than the 50 ppm value for hydrocarbons and the 0.5 value for carbon monoxide that may be established for new internal combustion engines. Emissions of nitrogen oxides are the same order of magnitude as those for a spark ignition engine. These can be reduced at the expense of engine thermal efficiency by lower combustion air-inlet temperature, leaner air-fuel ratios, and an exhaust gas recirculation system.

20134

Sullivan, J. L.

AIR POLLUTION--CAUSES AND CONTROL. Occupational Health Rev. (Ottawa), 20(3-4):9-23, 1968-69.

Pollution due to the burning of liquid and gaseous fuels, and industrial emissions is discussed; methods for measuring solid particles and gases are described, and their prevention or elimination is considered. Gasoline internal combustion engines seldom burn fuel completely, resulting in discharges of carbon monoxide and hydrocarbons, while nitrogen oxides occur as the combination of nitrogen and oxygen in air under the influence of high temperatures inside the cylinders of the engine. These compounds are significant as components of sunlight-induced or photo-chemical pollution, causing eye irritation, and damage to vegetation and materials. Diesel exhausts discharge greater quantities of carbon particulates and odorous materials, partly attributable to aldehydes and other fuel decomposition products, than the emissions of the gasoline engine. Lead, zinc, copper and nickel smelting release large quantities of sulfur dioxide, while the manufacture of iron and steel causes visible fine particulate plumes. Gaseous and solid fluoride compounds are evolved by the electrolysis of aluminum oxide, and paper manufacturing results in the escape of odorous sulfide and mercaptan compounds. Soot or dust-fall can be collected very simply in open-top gauges, separated from the water by filtration, then dried and weighed; dust can be measured by means of a device similar to a vacuum cleaner, in which a sample of air is drawn through a filter, composed usually of paper or fibre-glass, and the quantity of dust is determined by subtracting the previously-determined weight of the filter. Gases are often measured continuously by absorption of infrared or ultra violet electromagnetic rays. Legislation for the reduction of emissions has two main objectives: to extablish standards and to enforce them. It is preferable to employ methods which do not create pollution, but filters are mentioned for the many processes which cannot avoid generating dust. Pollution control has been a provincial responsibility in Canada, and specific acts of legislation are cited.

20276

Rue, Phillip G. La

ELECTRIC SMOKELESS AND ODORLESS INCINERATOR. (Calcinator Corp., Bay City, Mich.) U. S. Pat. 3,496,890. 6p., Feb. 24, 1970. 4 refs. (Appl. Nov. 6, 1967, 9 claims).

A smokeless and odorless incinerator for burning garbage and other refuse is described. The refuse is placed in a primary combustion chamber where it is ignited by mounted heating elements. An afterburner is provided which reburns the smoke and gases as they flow from the primary chamber. The remaining unburned refuse in the primary chamber is dried up by a second heating device before being burned. The heating elements may be open coil resistance wires which are protected by a grid placed between them and the refuse. The second heating device is preferably placed from the bottom of the primary chamber. (Author abstract modified)

20553

Sullivan, Ralph J.

PRELIMINARY AIR POLLUTION SURVEY OF ODOROUS COMPOUNDS. A LITERATURE REVIEW. Litton Systems, Inc., Silver Spring, Md., Environmental Systems Div., Contract PH 22-68-25, NAPCA Pub. APTP 66-42, 244p., Oct. 1969. 443 refs. CFSTI: PB 188089

Odors may cause mental and physiological effects in humans, such as nausea, headache, loss of sleep, loss of appetite, impaired breathing, and in some cases allergic reactions. Community and personal pride and status may be adversely affected. No information on the effect of odorous air pollutants on the health or behavior of domestic, commercial, or experimental animals was found in the literature. The petroleum industry, petrochemical plant complexes, chemical industry, pulp and paper mills, coke ovens, coal, iron-steel industry and foundries, food processing, meat industry (including livestock slaughtering, inedible rendering of animal matter, fish processing, tanneries, etc), combustion processes (including diesel engines), and sewage are listed as sources of odors. The literature contains no quantitative data on the odor concentration in ambient air. Surveys have been made, but they show only the detective disagreeable odors and not their intensity. Abatement methods fall into several categories: combustion, absorption, adsorption, odor masking, odor removal, chemical control, biological control, and containment. Combustion is generally accepted as the best way to deodorize malodorous gases. Oxidation at 1,200 F or above usually gives satisfactory results. Economically, odor pollution depresses property values. The human nose is the only reliable detector, and several laboratory and field methods (organoleptic methods, such as the vapor dilution technique and the syringe dilution techinque) and instrumental methods (such as gas chromatography) have been deveolped to quantify human observations.

20557

CHEMICAL IDENTIFICATION OF THE ODOR COMPONENTS IN DIESEL ENGINE EXHAUST (FINAL REPORT). Little (Arthur D.) Inc., Cambridge, Mass Contracts PH 22-68-20 and CD-13-64, Proj. CAPE-7, 92p., July 1969. 3 refs. CFSTI: PB 185878

As part of a total program related to the chemistry of diesel exhaust, odor compounds in diesel exhaust were characterized with respect to their type, intensity, threshold values, character, and possible contribution to human irritation. In addition, techniques were developed for separating the odor components from diesel exhaust. The odor profile of diesel exhaust at a 1/600 dilution in air describes three odor character notes - oily, burnt, and kerosene - and two feeling sensations - nose irritation and eye irritation. These five elements appear to vary in intensity as a function of diesel exhaust level in the test room. The system for separating the components of diesel exhaust uses silica liquid column chromatography followed by silicone and carbowax gas chromatography. Preliminary analysis shows that several individual components with odors relating to the burnt complex are present in sufficient concentration to permit identification, particularly with regard to the low-boiling-temperature fractions. The separation techniques should be sufficient for isolating the odor components related to kerosene and those which are described as oily.

20706

Shigeta, Y., Y. Hoshika, T. Ishiguro, and S. Tsuchihashi

THE RESEARCH OF BAD ODOR ON THE FISH MEAL PLANTS. (Gyochokotsu shorikojogun no akushu chosarei). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):86, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.)

In Shimonoseki, four plants in fishmeal and feather meal production as well as rendering were investigated as the source of obnoxious odors in the area. For all plants, the most odorous emissions originated from the fish meal dryers and the exhaust of the odor control equipment. Various strengths of odor are tabulated according to the emission source and the types of products. From odor measurements of the surrounding area by the syringe method, most of the extensive odor pollution was again found to originate from the dryers as well as the raw material storerooms. A questionnaire survey was conducted of the local residents, concerning meteorological conditions and subjective opinions on odors; it became evident that the odors from the dryers are spread out by the westerly wind, with high intensity even half a kilometer away. This influences the daily life of the residents as far as one to two kilometers away.

21395

Vogelhuber, W. W. and H. C. Parish

COMPACT LNG SYSTEM USING LARGE STIRLING CYCLE COLD GAS REFRIGERATOR. Inst. of Gas Technology, Chicago, Ill., Proc. Intern. Conf. LNG, 1st, Chicago, Ill., 1968, 12p. (April 7-12, Paper 5-28).

A liquefaction system is discussed which utilizes a Cold Gas Refrigerator operating on the stirling cycle to remove some or all of the sensible and latent heat from natural gas. For capabilities below about 1.4 MMCFD, the CGR system would be expected to have a lower initial cost than conventional systems. The unit comprises an ambient temperature drive and a cylinder assembly which houses a compression piston and a displacer piston, both coupled to a unique rhombic drive mechanism by separate connecting rods. The rhombic drive produces sinusoidal phased harmonic motions of the two pistons which alternately compress, transfer, and expand the working fluid (hydrogen or helium gas) within the cylinder. Space just beneath the displacer piston is used for compression, while the space above the displacer is used for expanding and cooling the working medium. These sections are connected by a channel containing three heat exchangers. If the refrigeration capacity requirement exceeds that of a single cylinder, two, three or four cylinders may be combined to form a single, multi-cylinder unit with a common drive shaft. An advantage of the multi-cylinder unit is the capability of operating the cylinders at different temperatures, while it is a relatively compact unit resulting in minimum field installation effort. The CGR unit can be charged, started and cooled to operating temperatures within ten minutes. It is generally insensitive to load variations and if load and capacity are unbalanced, the condensing temperature will change until a new equilibrium point is reached. Features of the CGR system promote its use in an installation where redundant refrigeration capacity is required, as in barge transport of liquefied natural gas or other cryogenic fluids.

21661

Kanno, Kyoichi

ON OZONE. Kuki Seijo (Clean Air - J. Japan Air Cleaning Assoc., Tokyo) 2(1), 1964. 11 refs. Translated from Japanese. Belov and Associates, Denver, Colo., 15p., April 7, 1970.

Some general aspects of ozone science and technology are briefly reviewed. The odor of ozone was first recognized preceding thunderstorms or near electric generators, and is chiefly due to impurities in the gas. The theory, testing, and temperature and humidity effects of ozone production by silent dischargers are discussed. Conflicting opinions exist concerning the poisonous nature of the gas, although it seems clear that impurities, concentration, and length of time of exposure are important parameters. Because of its strong tendency toward acidification, ozone has important bactericidal, bleaching, and anti-odor applications. In recent indoor air purification technology, polluted air may be passed through an ozonizer to kill constituent microorganisms with a heavy dose of ozone; the polluted and purified air are then mixed to gradually purify the total ambient atmosphere. As a powerful oxidizing agent, ozone is effective in counteracting the odors of such substances as oxides, mercaptans, skatoles, and indols. A brief description of chemical and physical ozone detection methods is also given. The physical methods are preferred because they are faster, continuous, and more readily adjusted for precise measurements and sensitive changes.

21700

Feitzelmayer Karl and Karl Conradi

DEVICE FOR IMPROVEMENT OF THE COMPOSITION OF THE EXHAUST OF DIESEL ENGINES DURING IDLING. (Vorrichtung zur Verbesserung der Zusammensetzung der Abgase von Dieselmotoren im Leerlauf). Text in German. (Maschinenfabrik Augsburg-Nuernberg A. G., Munich W. Germany)) Swiss Pat. 457 032. 3p. May 31, 1968. (Appl. Oct. 13, 1967, 1 claim).

Disagreeable odors in the exhaust of diesel engines during idling can be reduced by diminishing the fresh air supply. This is achieved by installation of a throttle valve in the fresh air intake duct which reduces the air supply in accordance with the lower fuel supply during idling. The position of the throttle valve can be adjusted by the piston of a pneumatic actuator, which is connected to the pneumatic control system. The latter operates the fuel control system.

21857

Hamanabe, Y., S. Harima, T. Miura, T. Domon, and T. Namiki

THE SENSITIVE MEASUREMENT OF BAD ODOR IN USING OF AN ODORLESS CHAMBER. (Mooshushitsoohoh ni yoloo shuki kannoh sokootei (II). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):115, 1969. 2 refs. (Proceedings of the Japan Society of Air Pollution Annual Meeting, 10th, 1969.)

The odor of methyl-mercaptan, ammonia, and dimethyl sulfide was measured using an odorless chamber from whose windows odor was sniffed by a panel of 5-6 members on the threshold level, environmental level, and nuisance level of malodor. The first level means the minimum one, when the odor starts to smell; the second one does not give any actual effects on the body; and the last one results in headache, nausea, reduced appetite, etc. The results in ppm for threshold level, environmental level and nuisance level, respectively, are as follows: methyl mercaptan: 0.0001, 0.02, and 1.0; ammonia: 0.04, 8.0, and 40; and dimethyl sulfide: 0.01, 2.0, and 10. Although the comparison is made between these individual odors and mixed odors, it is difficult to know their relationship.

21882

Franzke, H. H.

REDUCTION OF EMISSIONS AT REFUSE INCINERATORS. (Emissionsverminderung bei der Abfallverbrennung). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:313-317, 1970.

The heterogeneous nature of refuse material makes any reduction of emissions difficult. Incinerators primarily emit dust (1 to 20 g/cu m), sulfur dioxide and sulfur trioxide (500 to 2500 mg/cu m), hydrogen chloride (150 to 1500 mg/cu m), and odors. The Federal government has imposed emission limits on incinerators, namely 150 mg/cu m of dust for plants with a circulation of 1.5 tons/h, and 200 mg/cu m of dust and a carbon dioxide-content of 7% for plants with a capacity below 1.5 tons/h. Technical measures for the reduction of emissions are discussed in the VDI (Association of German Engineers) guidelines 2114 and 2301. High stacks help to reduce high emission concentrations. For flue gas cleaning, the gases must first be cooled to temperatures between 150 and 250 C, while the liberated heat can be used for power generation. If no heat utilization is contemplated, water or fresh air must be used for cooling the gases. Electrostatic precipitators are primarily used for dust separation in large incinerators. In storage bunkers an underpressure must be maintained to avoid spread of disagreeable odors.

21887

Franzky, U.

THE USE OF OXIDATION PROCESSES FOR REDUCTION OF ODOROUS EMISSIONS. (Ueber den Einsatz von Oxidationsverfahren zur Verminderung geruchsintensiver Emissionen). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:291-302, 1970. 29 refs.

Thermal waste gas treatment is by far the most efficient method, but also the one with the highest operating costs, for the reduction of odorous emissions from animal rendering, coffee roasting, pyrolysis of beech wood, and foundries. The waste gas is pressed into a combustion chamber where guide vanes impart a rotary movement to the gas. The oil or gas burner is tangentially attached to the cylindrical chamber wall. Waste gases from a coffee roasting plant could be cleaned from 575 mg C/cu Nm to 170 mg C/cu Nm when temperatures in the chamber did not exceed 485 C. Better results are obtained at temperatures between 680 and 800 C, while concentrations of more than 10 g/cu Nm in the uncleaned gas could be reduced to less than 100 mg C/cu Nm at 740 C. Catalytic oxidation has found wide-spread use in the past few years, in which it generally suffices to heat the waste gases to just 350 or 400 C. Thus, costs for energy can be saved. Catalysts with palladium or platinum as active ingredients are used. Efficiencies of 90 to 95% are achieved with this method, but a higher maintenance service is required. Deodorization of the air in a poultry farm and pig sty by addition of ozone was unsuccessful. Better results were obtained in a mink farm by soaking a bed of sand with potassium permanganate solution 100g/12 liter water, 1 liter solution per 1 sq m sand). Mink feces falling onto this soaked bed were deodorized to a large extent. No final results are available as experiments with this method are still in progress.

21978

Pustinger, J. V. Jr., F. N. Hodgson, J. E. Strobel, and R. L. Evers

IDENTIFICATION OF VOLATILE CONTAMINANTS OF SPACE CABIN MATERIALS. Monsanto Research Corp., Dayton, Ohio, AF Contract F33615-67-C-1357 Proj. 6302. Task 630204, Work Unit 008, AMRL-TR-69-71, 68p., Oct. 1969. 4 refs. CFSTI: N70-19600

Nineteen candidate space-cabin materials were tested to determine weight loss characteristics and to identify their gas-off products. The materials were screened initially, using thermogravimetric techniques for measuring weight loss at moderate temperatures (ambient to 68 plus or minus 2 C) for 22.5 hours in 5 psia nitrogen, to select those candidate materials that lose from 0.001 to 1.0 of their weight, excluding water. The selected materials were then stored in 9-liter chambers at 68 plus or minus 2 C for 72 hours and at 25 plus or minus 2 C for 30 days. Atmosphere in the chambers was oxygen at 5 psia. The gaseous contaminants evolved from the test materials were identified by combinations of gas chromatography and mass spectrometry. Gas- off products observed were mostly entrapped solvents. Only two materials exhibited excessively high (greater than 1.0) emission values. The thermogravimetric procedures for screening candidate materials provided a good measure of the rate of volatile emission. However, the use of this approach as a rapid screening technique requires excessive time.

22860

Chansky, Steven H., Anne N. Dimitriou, Edwin L. Field, Charles R. LaMantia, and Robert E. Zinn

SYSTEMS STUDY OF AIR POLLUTION FROM MUNICIPAL INCINERATION. VOLUME II. (APPENDICES). Little (Arthur D.) Inc., Cambridge, Mass., NAPCA Contract CPA-22-69-23, 312p., March 1970. 39 refs. CFSTI: PB 192379

Volume II of a three volume report presents, largely in tabular and graphic format, data pertinent to a systems study of air pollution from municipal incineration. The scope, conclusions, and recommendations are contained in Volume I; Volume III consists of a comprehensive bibliography. The cost of reducing solid waste to a workable size; processes, physics, and costs of reducing flue gas temperatures for compatability with air pollution control equipment; the stoichiometry of refuse incineration; operating experience on European electrostatic precipitators; by-product recovery, including paper, metal, and heat; composition of refuse; and the projected composition and quantities through the year 2000 are presented. A detailed description is provided of the incineration process from collection to disposition of residue, with consideration being given to equipment options; air pollution via odors, smoke, particulates, and gases; process control; waste water disposal; site requirements; buildings; and utilities. A specimen questionnaire is included that was used to obtain data from the industry on incinerator inventories, capacities, current design trends, and operating practices. Data obtained through the use of this questionnaire are presented and analyzed. The causes and extent of air pollution problems associated with municipal incineration are defined, and a data bank of incinerator emission data is presented. Causes and cures for incinerator deficiencies are discussed.

22973

Jensen, Robert M.

INTRODUCTION TO AIR QUALITY CONTROL. Pacer, 1(5):1-14, 1970.

The hazard of and the harm caused by air pollution depend upon concentration and exposure. As can be demonstrated statistically, the incidence of health hazards due to air pollution is about 100 times greater in a city than in a rural area. Transportation contributes nearly 60% of the total atmospheric pollution and yields 74,800,000 tons of pollutants per year; manufacturing is the next biggest producer at 23,400,000 tons per year. The biggest single pollutant is the 65,000,000 tons of deadly carbon monoxide which we pump into our atmosphere each year. There is a large and rapidly increasing amount of evidence which relates air pollution to chronic bronchitis and respiratory cancer. Air pollution damages crops, livestock, shrubbery, and trees. Fluorine compounds in forage will cause cattle to lose teeth and to have an overgrowth of leg bones and ribs. Odor from a rendering plant or from some chemical plants can depress the value of land for both commercial and residential use. New York City estimates that corrosion costs the city about $6 million per year. Alternatives in sulfur dioxide control include the use of fuels with no sulfur, removal of the sulfur from the fuel, and removal from the gaseous products of combustion.

22987

Ishiguro, Tatsukichi

ODOR REMOVAL AT FISH AND ANIMAL MEAL PROCESSING PLANTS IN NORTHERN EUROPE. PART II. (Hokuo ni okeru gyochokotsu, jukotsu shori koj no dasshu taisaku. sono ni). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(2):28-34, June 20, 1970.

Dank Andels Fish AMBA is a fish meal factory on an island of Denmar and owns nearly 200 ships which amounts to one-half of the all the ships on this island. The materials processed are mainly codfish and herring. The company processes between 4000 t and 5000 t/year. Plant equipped by Atlas, with indirect thermal dryers, are operated by five employees. As it is this factory that successfully commenced odor removal sooner than in any other country in Europe. there is little or no fish smell in this plant. As one of the biggest companies in Europe, Andels Sildeli Fabriken AMBA in Esbjerg of Denmark, runs nine plants with the capacity of 300 t/day and 150 employees process about 230,000 t in raw materials, about 40,000 t in fish meal, 13,000 t in soluble materials, and 12,000 in fish oil annually. Odor removal appeared rather poorly carried out at this plant. There is much to be improved on, especially washing as a whole. Blackird Moae Fabriken in Hanstholm, Denmark was under construction at the time of author's visit and is supposed to be currently operating. As briefly commented, although many were considered instructive with respect to fish meal processing there were few with odor removal so far. Reports of management aspects are presented.

23000

Ishiguro, Tatsukichi

ODOR REMOVAL AT FISH AND ANIMAL MEAL PROCESSING PLANTS IN NORTHERN EUROPE. PART I. (Hokuo ni okeru gyochokotsu, jukotsu shorikojo dasshu taisaku. sono ichi). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(1):38-45, April 20, 1970.

Various remarks on the fish meal processing factories in Northern Europe are presented. They are concerned with the present situation of fish and animal meal processing industries, general concerns of some plants for odor removal, facilities for odor removal, general conditions and outlooks of those buildings, maintenance of equipments, and specifically technical aspects of odor removal in practice. Two plants are introduced. Doggerbank Fishmelsfabrikken in Denmark specialize in herring with fat content of between 15 and 20% and processes 22,000 t/year (220 days worked in 1967) or 100 t/day. The workers numbered only three, operating the Alfa Laval equipment. The water consumed for both odor removal and washing totals between 45 cu m and 50 cu m/ hour. Fish odor can hardly be recognized, even inside the building. Eidelsteder Extraktions und Fishmeklwerke in West Germany processes between 400 and 500 t/day and the main material is fish rubbish, occasionally round herring and codfish. The building is equipped with two roter desk-dryers by Atlas with the capacity of 300 t/day and two cookers with the capacity of 250 t/day and of 150 t/day, respectively. The employees number 45. Odor removal is poor at this plant.

23313

Alkire, H. L.

AIR POLLUTION IN CAROLINE COUNTY MARYLAND. Maryland State Department of Health, Baltimore, Div. of Air Quality Control and Caroline County Dept. of Health, Denton, Md., 19p., Jan. 1970. 15 refs.

The present survey emanated from the need of the Division of Air Quality Control of the Maryland State Department of Health to have a county by county statement, based on available information, on the status of air contamination in the various areas. The survey was made in accordance with authority granted under the Maryland Air Quality Control Act (Article 43, Annotated Code of Maryland, 1957 Edition and Supplement). Regulations have been adopted by the county governing the control and prohibition of open fires, the control and prohibition of visible emissions, and the control and prohibition of particulate emissions from fuel combustion. Amendments to these regulations which became effective on January 29, 1969 govern the sulfur content of all heating oils and of oil used in very large installations after July 1, 1970; prohibit removing air pollution control devices from motor vehicles as well as requiring that the devices be kept in operating condition; provide for the control of the discharge of gases, vapors or odors; and, in addition, are concerned with control of visible and particulate emissions from industrial and incineration operations. Plants at Denton and Ridgely fortunately have been located so that those communities are upwind of the prevailing west and northwest winds. Two poultry processing plants create the types of odors usually associated therewith but they are rurally located. There are no plants for the rendering of inedible portions of chickens in the county. Five dumps are used for the disposition of about 8500 tons of refuse annually. The burning of material is on an irregular schedule and is somewhat controlled. However, material is not covered frequently and the dumps are odorous. Investigations are under way with the aim of substituting sanitary landfills for the dumps. The disposal of home-generated trash and leaves in smaller communities and by burning is a general practice. The processing of clams near Ridgely produces some odors which escape into the town and may lead to objectionable conditions. However, some residents of the area reported that they were not of an objectionable nature. Smoke has been emanating periodically from the stack of milk plant in Greensboro, but this is resulting from improper operation of new equipment which was installed to correct previously unsatisfactory smoke emissions.

23314

Alkire, H. L.

AIR POLLUTION IN TALBOT COUNTY MARYLAND. Maryland State Department of Health, Baltimore, Div. of Air Quality Control and Talbot County Dept. of Health, Easton, Md., 19p., Jan. 1970. 14 refs.

The present survey emanated from the need of the Division of Air Quality Control of the Maryland State Department of Health to have a county by county statement, based on available information, on the status of air contamination in the various areas. The survey was made in accordance with authority for the Secretary of Health and Mental Hygiene to adopt regulations governing the control of air pollution in the State. Regulations applicable in Talbot County have been adopted governing the control and prohibition of open fires, the control and prohibition of visible emissions, and the control and prohibition of particulate emissions from fuel combustion. Amendments to these regulations which became effective on January 29, 1969 govern the sulfur content of all heating oils and of coal used in very large installations after July 1, 1970; prohibit removing air pollution control devices from motor vehicles as well as requiring that the devices be kept in operating conditions; provide for the control of the discharge of gases, vapors or odors; and, in addition, are concerned with control of visible and particulate emissions from industrial and incineration operations. Most sources of air pollution in Talbot County, although relatively small and few in number, are clustered in the Easton area. Pollution generally is associated with the processing of vegetables, the shelling and drying of corn which create 'beeswing' chaff, and the processing of seafood. Other than in the Easton area, these are widely scattered and objectionable levels of pollution are localized. Almost all refuse material is disposed of in landfills. However, burning sometimes occurs at the Tilghman-Sherwood dump and occasionally at the St. Michaels dump.

23843

Merz, Otto

PRACTICAL DETERMINATION OF GASES FROM VARNISH DRYING OVENS. (Praxisnahe Bestimmung von Abgasen aus Lacktrockenoefen). Text in German. Blech, 15(1):12-16, Jan. 1968. 19 refs.

An exact chemical analysis of gases emanating from lacquer drying ovens which are a complex mixture of various organic compounds of unknown exact composition can be accomplished only by a combination of gas chromatography, flame ionization detection, and infrared spectroscopy. The emission consists largely of solvents which can be dealt with by catalytic combustion and of less than 1% decomposition products the smell of which is sometimes objectionable. Some sulfur dioxide is also generated if fuel oil is used in the installation. Maximal permissible work site concentrations and maximal permissible emission levels of various solvents and formaldehyde, furfurol, mono- di- and trimethylamine, mono- di- and triethylamine (which have in 1964 been reduced to up to one tenth of their former levels) are reviewed. Portable explosimeters are used for the determination of the concentration of combustible gases, vapors, and their mixtures with air for concentration within a range of up to the lower explosion limit. Especially suited for gas emanations from lacquer drying ovens are gas detectors using detection cartridges for almost all solvents and lacquer decomposition products such as phenol, monostyrol, polyacrylate, formaldehyde, and acrolein. A color conversion of the test substance in the cartridge represents a qualitative and sometimes a quantitative test of the presence of the objectionable substance. The presence of 100 mg hydrocarbon N/cu m is considered to be the upper permissible limit, but the figure is arbitrary because the olfactory threshold of various compounds varies widely.

24007

VAPOUR INCINERATION. Process Biochem., 5(1):54-56, Jan. 1970.

Direct-fired fume incinerators should destroy most organic particles as well as organic solvent fumes, while discharge to the atmosphere from the units is odor-free. The operation principle is to pass organic pollutants through a dwell or combustion chamber where they are raised to self-ignition temperature by contact with a direct flame so that all pollutants are oxidized to carbon dioxide and water. In general, exhaust gas discharge temperatures of 1200-1400 F are sufficient to reduce pollution in effluent by 85-95%. When the oxygen content of the effluent is high, it is recommended practice to use the effluent as either primary or secondary air for the combustion process. As the oxygen content in the effluent drops below 18%, it is advisable to use an increasing percentage of fresh air as primary and secondary combustion air. When effluent is used as 'air' for the combustion of the selected fuel, the temperature of the effluent 'air' should be controlled below 700 F, if fuel gas is used, to prevent cracking; if propane or butane is the fuel selected, an effluent 'air' temperature below 650 F is recommended. Formulae are provide for calculating the net or gross heat input required for the combustion of a given volume of effluent. Burner types are mentioned, including an AH-O-, TAH-O, RAH-, and TAH-R-type burner, as well as indications for their use.

24350

Copley International Corp.

NATIONAL SURVEY OF THE ODOR PROBLEM. PHASE I OF A STUDY OF THE SOCIAL AND ECONOMIC IMPACT OF ODORS. Contract CPA 22-69-50, 246p., Jan. 1970. 175 refs. NTIS: PB 194376

Information relative to the basic definition, identification, and assessment of the social and economic impact of odors is presented. In order to fully understand the odor problem, several tasks were defined, including: identification and description of major odors and sources; a survey of local air pollution control agencies; selection of several areas for investigations of actual problems; public opinion surveys; technical field investigations; and sensory evaluation of odor studies. Primary sources include meat packing operations, chemical plants, dumps and incinerators, and petroleum production. Results of the surveys and public opinion polls are discussed. The scentometer, a vapor dilution technique device, is a utilitarian and effective tool for odor problem identification. Many citizens are aware of and object to odor problems, but very few people are motivated to seek official recourse.

24459

Morriss, F. V., Calvin Bolze, and John T. Goodwin, Jr.

SMOG CHAMBER STUDIES OF UNLEADED VS. LEADED FUELS. Ind. Eng. Chem. 50(4):673-676, April 1958. 9 refs.

Because automobile exhaust gas has been implicated as a major source of smog-producing chemicals, it was undertaken to investigat the possible effect of tetraethyl lead and halogen scavengers used in antiknock fluids on smog manifestations. The major exhaust products from TEL and these scavengers are particulate solids from 0.01 micron to several millimeters in diameter, composed mainly of lead chlorobromide and alpha and beta forms of the binary complex of this halide with ammonium chloride. Experimental apparatus consisted essentially of two large glass reaction chamber built from a greenhouse, and equipped with air-sampling systems to measure the concentrations of various chemicals. Test fuels were burned in a 1952 Ford station wagon with an automatic transmission. When measurements were made of oxidants, eye irritation and odor, hydrocarbons, carbon monoxide, oxides of nitrogen, and aldehydes, no significant differences were found between leaded and unleaded gasolines.

24500

Mie Prefecture (Japan), Public Nuisance Control Bureau

REPORT ON THE SPECIAL INVESTIGATION OF AIR POLLUTION IN THE YOKKAICHI DISTRICT. (Yokkaichi chiku taiki osen tokubetsu chosa hokoku sho). Text in Japanese. 20p., March 19[illegible]4.

The industrial complexes in Yokkaichi consists of two large-scale complexes and a heavy-oil combustion steam power plant; the total amount of fuel oil used per year occupies 99% of the total. The complexes were built during the period of economic growth, and little attention was paid to public nuisance control. Winds blow NW in winter and SE in summer. The main pollutants are sulfur oxides arising primarily from heavy-sulfur oil combustion. The concentration sometimes goes up to about 0.2 ppm (electroconductivity method). Soot and dust particles are also a problem, but they are decreasing over the years due to the decreasing use of solid fuels. There are, however, individual factories that produce much soot and dust. Other pollutants include obnoxious odors and noise. The control measures involve enforcing environmental standards (tabulated); taking appropriate steps such as treating sulfur oxides arising from sulfuric acid manufacturing plants; restructuring the urban structure of Yokkaichi; creating buffer zones between factories and nearby residential areas; establishing clean-air rooms in medical facilities to treat the emergency cases of respiratory diseases caused by air pollution; creating an air pollution monitoring network; and building meteorological stations.

24527

Lunche, R. G.

VACUUM JETS. In: Emissions to the Atmosphere from Eight Miscellaneous Sources in Oil Refineries. Los Angeles County Air Pollution Control District, Calif., California Dept. of Public Health, Berkeley, Bureau of Air Sanitation, Public Health Service, Washington, D. C., Community Air Pollution Program, and Western Oil and Gas Assoc., Los Angeles, Calif., Air Pollution Control Committee, Rept. 8, Section 8, p. 47-51, June 1958. 9 refs.

A steam-driven vacuum ejector or jet, consisting of several ejector stages in series with interstage condensers, is the common method for producing and maintaining a vacuum in refinery process equipment. Malodorous hydrocarbon emissions were vented to the atmosphere as non-condensable gases from the last stage of the vacuum jet system. These emissions decreased progressively from 17 tons in 1951 in Los Angeles County to zero in 1957 as a result of control installations, which condense as much of the vacuum jet effluent as is practical and recover the remaining gases and vapors, which are then vented to a fume incinerator or firebox. The liquid condensate can be separated into water and hydrocarbon. No testing program was conducted, since all known refinery jets are under control.

24754

Franzky, U.

RESULTS OF THERMAL AND OF CATALYTIC PROCESSES TO LIMIT OLFACTORY EMISSIONS OF ORGANIC CHEMICAL COMPOUNDS. (Ergebnisse thermischer und katalytischer Verfahren zur Einschraenkung geruchsintensiver Emissionen organisch-chemischer Verbindungen). Text in German. Landesanstalt fuer Immissions-und Bodennutzungsschutz, Essen (West Germany), 9p., 1970 (?). 13 refs.

A reliable process for the elimination of emissions of organic chemical compounds with an objectionable smell is thermal combustion. Organic compounds are completely destroyed by heating the exhaust gas flow to above 800 C for a sufficiently long time. The process is expensive because the oxidation does not generate heat. The concentration of olfactory substances is always minute and all heat for the combustion has to be provided from the outside. Catalytic combustion which achieves satisfactory combustion at temperatures between 350 and 400 C is therefore used more frequently. Such temperatures can often be produced by means of heat exchangers. But catalytic purification cannot be applied universally because dust and other admixtures (phosphorus compounds for example) can prematurely deactivate the catalyst. With catalytic combustion at temperatures above 350 C, residual concentrations are largely independent of the nature and quantity of the original impurities. The effectiveness of these processes is judged by the carbon content of the gas before and following combustion. Thermal and catalytic installations designed to reduce objectionable emission from lacquer drying furnaces, from polyvinyl chloride jelling canals, from coffee and malt roasting drums, from curing chambers and other emission sources are described.

24903

Wright, R. H.

IS IT POSSIBLE TO BUILD AND OPERATE A COMPLETELY ODORLESS KRAFT MILL? Can. Pulp Paper Ind. (Vancouver), 10(9):21-22, 24, 26, 28, 30, 32, 34, Sept. 1957.

It is possbile to build a completely odorless kraft mill if management is willing to pay the price. The initial down payment would pay for odor control equipment; the direct installment payments are the costs of maintaining all the odor control equipment at top efficiency; indirect installment charges occur whenever it is necessary to limit production to prevent odor emission. Most kraft odors are due to organic sulfur compounds such as methyl mercaptan and its oxidation products. The kraft operation also emits particulate matter, mostly compounds of sodium. The sources of emissions are discussed, and control measures are described. Dusts are usually removed by a combination of scrubbers, bag filters, or electrostatic precipitators. The process of black liquor oxidation is discussed. When it is properly oxidized, the release of odors from black liquor is greatly curtailed. Research in the areas of contaminant identification and quantification is necessary in order to get a better understanding of effective design characteristics.

25056

Ishii, Kazuo, Matsuoki Okuda, Mutsuo Koizumi, Tadahiro Machiyama, Katsuya Nagata, and Noboru Sugimoto

HIGH PERFORMANCE INCINERATION OF SEWAGE SLUDGE. PART II. INCINERATOR WITH SLAG-TAP FURNACE. (Konoritsu no gesui odei shokyaku sochi ni kansuru kenkyu. ni. Yukaishiki odei shokyaku sochi). Text in Japanese. Nenryo Kyokaishi (J. Fuel Soc. Japan, Tokyo), 49(521):674-682, Sept. 20, 1970. 7 refs.

A new type of incinerator with a slag-tap furnace for dewatered sludge consists of an atomizing feeder of sludge, a heat exchanger, an air preheater and a cyclone dust collector. The air-jet type sludge atomizer, referred to in Part I of the article, and a heavy fuel oil burner are placed at the top of the furnace. Refractory materials which are packed in the furnace are suspended by five water-cooled tubes with refractory coating and are heated by firing fuel oil. Dewatered sludge is fed in particulate form and burned immediately when it gets in contact with the high temperature, high speed combustion gas of the fuel oil. Ash in the sludge is melted into slag and flows down into a slag pit through the bank of refractory materials. The incinerator system has the following merits: dustless flue gas is emitted from the furnace, because the ash in sludge is melted into slag at the bank of refractory materials; flue gas is odorless because of high temperature combustion; and the incineration plant can be compact in size and still possesses high performance. This type of incinerator is used more effectively for dewatered raw sludge than for dehydrated sludge, just as in the case of the AST method, since dewatered sludge contains more water and is more convenient for transportation and dispersion. Further, since dewatered raw sludge has not gone through digestion, it contains more organic matter and emits higher heat. The system is applicable to not only sewage sludge, but also for burning sludge in factory effluents which hardly contains any flammable matter, or the sludge which is especially high in water content. The system is only a small test incinerator, with only 100 kg/h capacity. After more experience is gained in taking out melted ash and in testing durability of the incinerator, more problems will be solved.

25179

Huch, Rheinhold, Helmut Beine, and Werner Brocke

STUDIES AND DEVELOPMENTS ON THE REDUCTION OF ENVIRONMENTAL ODOR MOLESTATION. Preprint, International Union of Air Pollution Prevention Associations, 82p., 1970. 13 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11 1970, Paper EN-28A.)

The county of Northrhine-Westfalia has widely financed a group of projects dealing with the increasing environmental pollution by odors; known and new basic techniques and concepts had to be checked, developed, or modified. 'Run' experiences, attainable limiting values of emissions, and also failures, which at least have brought about clearness concerning some control techniques are discussed: thermal combustion in food-smoking and coffee- roasting plants and in processes producing color-malt and some special products; the catalytic combustion of organic atmospheric contaminants, mainly in the flue gases of a starch factory, at the casting of cores in foundries, from jellying channels, printing works, from the production of grinding wheels and mineral fiber mats, and from some special sources; the removal of organic compounds and of hydrogen sulfide with wet processes from the flue gases of plants processing phenolic resins, coating, impregnating, and varnishing textiles, a beer-wort boilery, an establishment pre-frying apple fritters, and of some plants with low hydrogen sulfide concentrations in their exhaust air; the application of ozone and ultraviolet irradiators to purify air contaminated by intensive animal farming; the treatment of feces of a mink farm with chemicals to suppress the development and release of odoriferous substances; and the recovery of the solvent or diluent in dry cleaners with active coal. It was found that thermal combustion rather often proved to be superior to catalytic combustion for its greater operational stability, in spite of the lower process costs ascribed to the latter. Moreover the experiences investigated enabled legal definitions confining the emissions for two great groups of sources. These definitions cover dry cleaners and drying furnaces, drying, solidifying, or congealing organic substances in the most diverse plants. A review of the relevant experiences is included, the details giving some insight and stimulation to the research scientist, and enabling the technician to check whether a solution of his problems is possible in this, or a similar way. (Author abstract)

25205

Martin-Lof, Rutger

HOW THE SWEDISH PULP AND PAPER INDUSTRY COMBATS AIR POLLUTION. Preprint, International Union of Air Pollution Prevention Associations, 42p., 1970. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-28G.)

The sulfite pulp industry is responsible for more than half of the air pollution from the pulp industry in spite of the fact that the sulfite pulp production only amounts to about 29% of the total chemical pulp production. This is due to the fact that in the calcium sulfite process, at present the dominating sulfite process in Sweden, no method for chemical recovery is available. The production of sulfate pulp, sulfite pulp on a so called soluble base, and semichemical pulp is expected to increase and to be concentrated to a few large units, while the production of calcium sulfite pulp, is expected to cease in the long run. Dust emission emanates from soda recovery boilers, lime kilns, lye furnaces, and bark furnaces. Electrostatic filters are used at all Swedish sulfate mills for purification of the flue gases from the recovery boilers and at more than half of the mills there are scrubbers for washing of the gases as well. Flue gases from lime kilns are usually cleaned in a venturi gas scrubber. Dust separation from lye and bark furnaces are usually performed in cyclone type mechanical equipment. The emission of acidic gases consists of sulfur dioxide and some sulfur trioxide, and emanates mainly from the lye furnace for burning of the sulfite waste liquors and from the recovery boilers in the sulfate mills. As distinguished from the calcium-based sulfite process, the other pulping processes involve chemical recovery processes and the emissions are due to inevitable losses in the recovery processes. The emission of odorous substances on a large scale occurs in connection with the sulfate process only. In order to collect the odorous gases a pipeline can be set up through the sulfate mill. As a consequence of The Environmental Preservation Act, which came into force in Sweden on July 1, 1969, the nature conservation authorities and the pulp and paper industry have in close collaboration carried out a very comprehensive investigation comprising the charting of existing emissions and an examination of the technical and economic possibilities of lowering these emissions. On the basis of these investigations, The National (Swedish) Environment Protection Board has issued recommendations for restriction of emissions at air polluting establishments. The investments in water and air preservation measures are expected to amount to about 10% of the total investments in the pulp industry. (Author abstract)

25228

Hicks, Ronald

ODOUR CONTROL IN WASTE-WATER TREATMENT SYSTEMS. Preprint, International Union of Air Pollution Prevention Associations, 38p., 1970. 10 refs. (Presented at the International Clean Air Congress 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-34B.)

As sewers become extended, odors have often been increased by the longer time of passage through the sewerage system, and the increasing usage of household garbage grinders has interfered with both flow rates and strengths. Industrial wastes have also been increasingly diverted into municipal sewers and many types of wastes from abattoirs, meat cooking, food processing, brewing, tanning, and wool scouring have contributed in increasing quantity, both to the variety and intensity of the prevalent odors. Control measures demanded by air pollution control officers at meat and fish-cooking factories, include condensation of volatile matters previously discharged into the air, resulting in liquid trades waste of high odor levels being discharged into the sewers. In the factories themselves, and in the smaller pumping stations a reasonable degree of odor control has been established by the use of masking agents, of chlorine compounds, and of ozone by injection techniques. Dry towers have included the use of regenerative resins, specific for amines and sulfides, as well as activated carbon. Wet scrubbing methods, on a small scale, have proved effective for a range of odors when permanganate solutions, hypochlorite solutions, and solutions containing chelated iron compounds have been used. On a large scale, where large volumes of contaminated air have needed odor control, water scrubbing and hypochlorite scrubbing did not prove economically practicable, but a filtration system depending upon short-time contact with a biologically-active surface, preferably where nitrification is actively taking place, has been found to give a high degree of odor removal with relatively short retention periods and involving low energy input to conveying fans. Chemical determinatons of odorant compounds were used for volatile gases such as hydrogen sulfide, ammonia, and a limited number of known amines. In the case of hydrogen sulfide, continuous monitoring with lead-acetate impregnated tape was carried out with the major pilot plants. The use of gas-chromatography was attempted for determinaton of the input and output concentrations of many odors not chemically measurable but without much success, although pre-concentration techniques were employed, using either dry ice or liquid air surrounding packed columns. A reasonable indication of odor intensity was given by using a splitter tube on the line between the evaporated concentrate and the chromatograph input, so that what was recognized nasally by the operator, could be related to the corresponding instrument record. (Author abstract)

25327

Stockham, J., A. O'Donnell, and A. Dravnieks

CHEMICAL SPECIES IN ENGINE EXHAUST AND THEIR CONTRIBUTION TO EXHAUST ODOR. (FINAL REPORT). IIT Research Inst., Chicago, Ill. Technology Center, Rept. IITRI C8150-5, 92p., June 30, 1969. 6 refs. CFSTI: PB 189651

High-resolution gas chromatography was used to separate the organic components of diesel engine exhaust and evaluate their contribution to exhaust odor. Specialized sampling procedures excluded water vapor collection and provided an enriched sample for analysis without the use of solvents. Exhaust components were classified into two general groups: those that are most probably odor irrelevant, and those that may contribute significantly to exhaust odor. Between 1000 and 2000 compounds were estimated to be present in diesel exhaust. The majority were saturated and unsaturated hydrocarbons that independently were relatively minor contributors to the overall odor character of diesel exhaust, but collectively may be responsible for the oily note of the exhaust. To the present, about 50 compounds were strongly odor relevant, and approximately 10 of these were very strongly odor relevant. The most likely chemical class of these 10 components is aldehydic, quite likely with an unsaturated structure containing one or two double bonds and probably including branched chain molecules. Di-aldehydes were apparently absent. The strongly odorous compounds were encountered throughout the boiling range investigated (30 to 260 C). The gas chromatographic columns used did not permit elucidation of the role free fatty acids and phenols may play as contributors to exhaust odor. The intensity of diesel exhaust odor was not significantly lowered by removal of the particulate matter present in the exhaust. The intensity reference standards for diesel exhaust odor developed by Professor Amos Turk correlated satisfactorily with the IITRI nine-port olfactometer using n-butanol as the odorant. No significant changes in the Turk intensity scale occurred over an 18 month shelf-life test. (Author abstract)

25455

Milks, D., C. W. Slavery, J. L. Steinberg, and R. A. Matula

STUDIES AND ANALYSIS OF DIESEL ENGINE ODOR PRODUCTION. Preprint, International Union of Air Pollution Prevention Associations, 46p., 1970. 31 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper EN-5E.)

Experimental methods for odor measurement, determination of the composition of diesel exhaust, experimental simulation studies, and proposed odor control techniques were reviewed. The experimental facilities, results of simulation studies, and the direction of the diesel odor research program at Drexel University are summarized. Both a single cylinder CFR diesel engine and a laboratory spray burner operating on pure hydrocarbon fuels are used to simulate diesel exhaust. Combined gas chromatographic- mass spectrometric techniques have been developed to determine the components of diesel exhaust which are collected in cold traps. The effect of compression ratio on the exhaust gas components in the aqueous condensate collected at O C from a CFR engine operating on n-hexadecane under lightly loaded, low speed operating conditions is reported. The design of laboratory Ospray burner experiments in which the nitrogen in air is replaced by monatomic gases and carbon dioxide are also discussed. Calculations which can be utilized to estimate the effects of substituting rare gases and carbon dioxide for nitrogen on the flame temperature and physical ignition lag in burner experiments are reported. It is concluded that effective control of diesel odor hinges on the isolation and identification of the compound or compounds which are the primary contributors to diesel odor. (Author abstract modified)

25638

PROTECTION AGAINST IMMISSION. (Immissionsschutz). Text in German. Rheinisch-Westfaelischer Technischer Uberwach.- Verein E.V., Jahresbericht, 1969:38-41, 1969.

The five principles promulgated in the framework of an intensified air pollution control campaign by the state of Nordrhein-Westfalen and adopted also by the other West German states postulate that all polluters be identified and included in the pollution control program, that the atmosphere be kept as clean as possible and not as dirty as just about tolerable; that the costs of the program be born equally by all polluters so that no competitive advantages arise; that the polluters bear the cost of their pollution control measures and public funds be used only in special situations; and that air pollution control as a community responsibility requires the cooperation of all concerned. Thus, all polluters are subject to certification and must meet all prescribed maximal emission regulations pertaining to dust emission, SO2 emission, and other applicable regulations. Fluorine is emitted by brick factories in quantities between 30 and 300 mg/N cu m, by cupola furnaces in quantities between 4 and 280 mg N/cu m, by Siemens-Martin furnaces in quantities between 7 and 70 mg N/cu m, by fertilizer plants in quantities between 6 and 80 mg N/cu m and by plants manufacturing insulating wool in quantities between 0.4 to 3 mg N/cu m. Guidelines regarding the required height of smoke stacks, emissions by refuse incineration plants, supervision of pollutant concentration and emission of pollutants, control of emission by boiler plants, control of olfactory pollutants and of noise pollution are outlined.

26048

Yasui, N.

LIGHT OIL AS DIESEL ENGINE FUEL AND ITS PROBLEMS. (Diizeru keiyu no doko to mondaiten). Text in Japanese. Sekiyu Gakkai Shi (J. Japan Petroleum Inst., Tokyo), 13(11):13-22, 1970. 131 refs.

The use of light oil as a fuel for internal combustion engines, particularly automobile diesel engines, is discussed. In Japan, consumption of light oil by automobiles reached 10.8 mil kl in 1970 and is projected to reach 16.7 mil kl in 1974. Quality standards by which to classify light oil are briefly reviewed. The all-purpose light oil used in Japan has an average specific gravity of 0.830-0.833, an average viscosity of 3.1-3.6 CST, an average sulfur content of 0.5-7%, and an average cetane value of 54-57. Temperatures required for 90% distillation and pour point are 205-312 C and -17 to -15 C, respectively. The direct injection system is increasingly preferred over pre-combustion chambers for 4-cycle, high-speed diesel engines. Problems associated with obtaining high-speed combustion in the direct injection systems are noted, as are the problems of reducing combustion noise and density of exhaust gas. Compared to gasoline engines, diesels omit much less carbon monoxide and smoke but more nitrogen oxides and aldehydes; the latter contribute to the odor of diesel smoke. The mechanism of diesel smoke generation, its measurement and control, and other related problems are also considered.

26402

Blythe, D. J.

LEAD AND ARSENIC REPORT. INFORMATIVE REPORT NO. 1. J. Air Pollution Control Assoc., 10(4):296, 343, Aug. 1960.

Methods in current use to control metallurgical fumes produced during the smelting, refining, and alloying of secondary lead and its alloys are reported. In plants where secondary lead smelting with either a blast furnace or a reverberatory furnace involves treatment of scrap lead, heavy metallic odorous fumes are generated which must be filtered through cloth bags of over 99% efficiency before emission to the atmosphere. Though less efficient, the fumes are sometimes passed through settling chambers or water spray curtains. Where local emissions regulations are very strict, hot furnace emissions are passed through cooling tubes into a baghouse for filtering; the collected material is then sintered for recharging into the furnaces. The gas stream may be passed through an electrostatic precipitator before stack discharge, and additional steps may be taken to eliminate odorous sulfur compounds and sulfur dioxide from the stack gases. Control of emissions from refining and alloying secondary lead are simpler than those from scrap treatment, and involves mainly collecting the fumes from kettle hoods and passing them through a baghouse for filtering. When arsenic is an alloy component, collected kettle fumes are removed by fan into a cooling unit and then filtered through a 99%-efficient baghouse before discharge.

26574

Ishii, K.

JET-TYPE WASTE LIQUIDS INCINERATOR. (Funmushiki haieki shoyakuro). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 22(12):10-15, Dec. 1970.

The choice of a method for incinerating sludge depends on whether the sludge is solid, liquid, or fluid. When the sludge is transportable by pump, jet-type incineration can be adopted because the pressure is easily determined. Since long fibrous material would clog the nozzle tips, this type of incineration requires close attention to the size of sludge particulates. Provision must also be made to eliminate dust, odor, and poisonous gas from the exhaust. In addition, it is necessary to know the amount of heat generated by the waste liquid to determine the amount of chemicals required for incineration. The COD value, as determined by the potassium bichromate method, can be regarded as the theoretical amount of oxygen in the waste liquid. A formula is given for determining the relationship between the degree of heat generated by the waste liquid and the required amount of supplementary fuel. The most widely-used supplementary fuel is C heavy oil; it cannot be used, however, where exhaust gas regulations are stringent. Digestion gas can be used by sewage-treatment plants and blast furnace gas by steel mills. Depending on the method of incineration, burners for liquid waste are classified into evaporation, 2-fluids burner, screw feeder, and emulsion types.

26575

Atarashi, Y.

INCINERATOR FOR WASTE RESINS AND ANIMAL CORPSES. (Jushirui oyobi dobutsu obutsurui shokyakuro). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 22(12):21-24, Dec. 1970.

An incinerator for waste resins and an incinerator for animal carcasses are described, each of which is lined with special fire-proof material. In the two-chamber resin incinerator, gas and air are fully mixed in the second chamber to insure effective contact between the wastes and the burner flame. No black smoke is released from the incinerator. Burners on each of the side walls of the second incinerator promote the thorough incineration of animal wastes on a hot hearth. The heat generated is used to reheat the burned gas and destroy odors.

26605

Takuma Boiler Mfg. Co. (Japan)

INCINERATOR FOR CITY WASTES. (Toshi gomi shokyakuro). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 22(12):5-9, Dec. 1970.

Continuous municipal incinerators are described which produce a minimum of smoke, odor, and noise and are combined with boilers utilizing the residual heat. Capacities of the incinerator range from 30-70 tons/day to 150-300 tons/day and over. The incinerators are characterized by a special stoker that stirs the refuse and dries it using radial heat from the furnace. Hard-to-burn material is further treated in rotary-type post-incineration equipment. A model available for small cities consists of vibrating, staircase-like grids along which refuse is moved and on which it is vibrated and dried. A provision for pre-heating of air in the chimney stack helps insure economic incineration. The temperature inside the incinerator varies little because of the continuous movement of dry waste along the grids; adequate ventilation is produced by the vibration of the grids. At the point where ash is removed from the incinerator, the gas is cooled by high-pressure water jets to prevent the emission of effluent. From the incinerator the collected ash is carried by conveyor to an ash bunker.

26826

Okamoto, Mansaburo, Hajime Fukui, Senzo Kawai, Susumu Takada, Toshio Tada, and Junichi Ueda

CONTROL OF OFFENSIVE ODOR IN A FISH-MANURE MILL BY MEANS OF COMMUNITY OPINION. (Kaseijo setsubi kaizen ni yoru akushu kogai boshi no koka kansatsu). Text in Japanese. Nippon Koshu Eisei Zasshi (Japan J. Public Health), 17(6):299-306, June 1970. 9 refs.

Investigations were carried out before and after a fish-meal plant enclosed its fish-manure mill operations. The purpose was to evaluate the effectiveness of the enclosed operations in reducing offensive odors. In addition to chemical analysis of air at the mill site and of mill drainage, each investigation involved a survey of 282 randomly selected housewives who were questioned abou their reactions to mill odors. While the second chemical examination indicated no remarkable changes, the second survey produced a considerable decrease in the number of complaints. Henc an area survey, when used in conjunction with chemical analysis, is a valuable tool for measuring nuisance from odors. Such a survey should consider the age and length of residence of the subjects as well as the distance and direction of their households from the source of the odor.

26911

Perrine, Richard L.

INTRODUCTION AND SUMMARY. In: Project Clean Air. California Univ., Berkeley, Task Force 5, Vol. 1, Section 1, 9p., Sept. 1, 1970.

Agriculture and forestry both are affected by and contribute to air pollution. Project Clean Air will establish a centrally located information center to collect and disseminate technical information on air pollution and provide educational materials and services. Use of power has grown at an alarming rate, and Project Clean Air will participate in the development of both selection criteria and basic data needed to facilitate energy management in California. More accurate methods will be developed by which to assess the economic losses to agriculture and forestry resulting from air pollution. A comprehensive program of research will be developed to determine: the growth depression effects on plants due to long-term low-level exposure to ethylene, sulfur dioxide, fluoride, and oxides of nitrogen; the extent of synergistic effects of combined sublethal concentrations of air pollutants on plants; the effects of air pollutants on the biochemistry, metabolism, and anatomy of plants; and the quality of the forest air environment where new damage is suspected. Ways and means to alleviate or modify agricultural, forest, and wood processing residue burning so as to minimize its contribution to air pollution are also indicated. A major program of research will be developed to make the expected transition to primarily nuclear power generation a safe one. Research will be developed to reduce nitrogen oxide emissions by means of combustion control, and several parallel projects will be developed to determine the potential usefulness of post-combustion removal of nitrogen oxides. Other recommendations include a program relating animal health to pollutants transported by air, ways to reduce dust resulting from livestock and poultry operations, and means to eliminate objectionable odors. The hazard from pesticide drift needs to be reduced, as well as sulfur dioxide emissions; industrial hydrocarbon and carbon monoxide emissions also need to be controlled. Project Clean Air will support research in which process engineering, meteorology, and economics are brought together to develop methods and criteria to optimally site the industrial emission sources which are currently most costly and hazardous.

27129

Merrion, David F.

DIESEL AND TURBINE DRIVEN VEHICLES AND AIR POLLUTION. Preprint, Missouri Univ., Columbia, 8p, 1969. 20 refs. (Presented at the Conference on Air Pollution, Columbia, Mo., Nov. 18, 1969.)

Superior combustion resulting from a needle valve fuel injector has reduced emissions of carbon monoxide, hydrocarbons, odor, and smoke from the GM Series 71 diesel engine, which is used in trucks and buses. The engines also demonstrate improved thermal efficiency and durability. However, the new injection system and an increased compression ratio have increased nitrogen oxide emissions. On the basis of mass emissions, the 71 engine emissions are within the range of all diesel emissions with hydrocarbon emissions on the low side and carbon monoxide and nitrogen oxide emissions in the mid-range. Carbon monoxide and hydrocarbon emissions from the gas turbine are lower than the best diesel, while turbine nitrogen oxides are within the range of the best diesel.

27235

Prowler, Mill[illegible] E.

ROOF-TOP INCINERATOR PREVENTS AIR POLLUTION. Environ. Control Management, 141(2):18-19, Feb. 1971.

A roof-top incinerator was installed to burn the effluents from drying and heat-setting processes which vaporize yarn paraffins and waxes, spinning oil, dye solvents, and resins at about 325 F. These fumes contain paraffinic and olefinic compounds which give rise to dark smoke and unpleasant odors. Ducts convey gases from the range on the top floor of the plant to the roof-top; a 40-hp fan discharges into one side of the incinerator inlet chamber. The register within the inlet chamber directs the incoming gases at right angles, through a circle of fire created by the ring-type burner, and into the combustion chamber. The burner flame ignites the impurities in the gas stream and they burn to completion in the combustion chamber at about 1500 F. A certain amount of gases from the range bypass the burner and enter the combustion chamber directly, through ports in the refractory wall between the inlet and combustion chambers. Cleaned gases from the combustion chamber enter the stack via the stack elbow, and are exhausted to the atmosphere. Flow of fuel gas to the burner is controlled by two solenoid operated shut-off valves and a solenoid operated bleed valve. A pressure regulator in the supply line evens out pressure fluctuations in the fuel supply to assure uniform burning.

27249

Hurn, R. W.

AIR POLLUTANTS FROM INTERNAL COMBUSTION ENGINES. Preprint, American Inst. of Aeronautics and Astronautics, New York, 14p., 1971. 3 refs. (Presented at the Aerospace Sciences Meeting, 9th, New York, Jan. 25-27, 1971, Paper 71-122.)

The basic engine and fuel factors which influence pollutants are discussed in the context of achieving low emissions; the penalty to performance, if any, is also discussed. Advantages and disadvantages in the use of lead-free gasoline, natural gas, and propane are reviewed. Finally, the more prominent characteristics of the several types of internal combustion engines are summarized with respect to the potential each holds for development to meet clean-air requirements. With less air than required for complete combustion, carbon monoxide is produced in addition to the dioxide and, typically, more hydrocarbon is left unburned than is the case with fuel-lean mixtures. In spark ignited engines, very lean mixtures tend to misfire with a resultant sharp increase in hydrocarbon emissions. Ignition timing and injection also have an influence on hydrocarbon emissions. The concentration of oxides of nitrogen in combustion gases is dependent primarily upon peak flame temperature reached in the combustion, but oxygen availabilit and time-temperature history also have an influence. While the relationship to combustion parameters is not well defined, it is believed that aldehydes are produced as intermediates in the combustion process. High temperature stress upon fuels in the presence of oxygen yields aldehydes, and they therefore are produced in misfire of very rich mixtures and in quenched or partial combustion. Smoke is produced when fuel is burned with insufficient oxygen. Although odor sources and originating mechanisms are very poorly understood, attention to efficient air utilization and some engineering measures are effective in reducing combustion related odor. The amount of carbonaceous particulate is related primarily to the availability of oxygen and to quenching in the combustion process; the amount of lead particulate is related to lead in gasoline.

27451

Lozano, Eloy R., Walter W. Melvin, Jr., and Seymour Hochheiser

AIR POLLUTION EMISSIONS FROM JET ENGINES. J. Air Pollution Control Assoc., 18(6):392-394, June 1968. 8 refs.

Air pollution emissions from three types of turbine engines are characterized and a method for estimating the magnitude of air pollution emissions due to commercial jet aircraft operations is presented. These engines are: the T-56 turboprop engine manufactured by the Allison Corp. and used to power the AF C-130 and the Lockheed Electra; the J-57 conventional jet engine manufactured by the Pratt and Whitney Corp. and used on the AF B-52 the Boeing 707, and other aircraft; the TF-33 fan-jet engine also manufactured by Pratt and Whitney and used on the Boeing 707, 720, and Douglas DC-8. Power settings, fuel flow, and other performance specifications of the three engines are presented tabularly. JP-4 fuel was used. Sampling apparatus and the analytical methods used are summarized for the determination of oxides of nitrogen, nitric oxide, carbon dioxide, total aldehydes, formaldehyde, carbon monoxide, total hydrocarbons, paraffin, olefin, aromatic characterization, particulates, and odor threshold. In TF-33 exhaust the volume percent of nitric oxide in the total nitrogen oxides varied from 82 to 93%, and in J-57 exhaust the percent composition varied from 62 to 76% depending upon engine power setting. Percent composition of nitric oxide was greatest at the 'take-off' power setting and lowest at 'idle'. Photochemically reactive hydrocarbon content of T-56, J-57, and TF-33 exhaust represented 35, 51, and 40%, respectively, of the total hydrocarbon emitted. Olefin content was significantly greater than aromatic content in TF-33 exhaust. The formaldehyde content of the aldehydes measured was greater than 60% in J-57 and T-56, except at the idle power setting in T-56 exhaust when it was 38%. Carbon monoxide and hydrocarbon concentrations in exhaust products generally increased with decreasing engine power setting and nitrogen oxide concentration generally increased with increasing engine power setting. Odor dilution threshold varied from 15 to 1000, depending upon engine type and power setting. It is greatest for the fan-jet engine at the idle power setting. Further tests on emissions of particulates would be desirable.

27669

Nagoya Municipal Office (Japan)

GUIDANCE GIVEN ON POLLUTION IN NAGOYA CITY, 1968. (Nagoyashi kogai shido jokyo). Text in Japanese. 63p., March 1970.

Complaints made during 1968 concerning pollution are outlined, showing an increase over the preceeding year of 9.4%. Since 1964, the total number of complaints has increased by approximately 12.5% each year, although the percentage of particular types of complaints to the total has remainded almost unchanged: sooty smoke, 13-16%; dust, 8-12%; gas, 1-3%; odor, 11-13%; effluent, 2-4%; noise, 47-49%; and vibration, 9-12%. There were a greater number of complaints in areas with a higher concentration of buildings. More complaints were received during the summer months, particularly pertaining to noise, while complaints concerning sooty smoke were greater during the winter. Approximately 80% of the complaints concerned factories employing less than 49 workers. These smaller enterprises mingle with residences and, financially and technically, they find it difficult to take the necessary steps to prevent pollution. With respect to the smaller enterprises, 53.8% of the complaints pertained to noise, while there were more complaints about odors, gases, and effluents from the larger industries. According to the type of enterprise, 44.0% of the complaints concerned the manufacturing of metal products, 8.4% lumber and wood products, and decreased with textile, chemical petroleum and coal products, cement and others. More than half of the complaints were solved, while 1252 enterprises were inspected.

27821

Kaplan, Lawrence M. and Arnold Risman

FIELD EVALUATION OF ON-SITE INCINERATION AND WASTE COMPACTION PROCESSES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 37p., 1970. 3 refs. (Presented at the Air Pollution Control Association Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-52.)

Several years ago, New York City established minimum requirements for the upgrading of existing on-site incinerators, which had been a significant source of particulate and smoke emissions. Subsequent source sampling revealed that no upgraded apartment house incinerator complied with particulate emission limits. Most of the incinerators tested were often misused or abused, either intentionally or through ignorance by improper maintenance and operation; furnace temperatures never reached the specified 14-1600 F range, and the smell of burnt garbage was generally noticeable in apartment house halls. Compactors are now being installed on 0new constructions and as an alternative to upgrading on-site incinerators. If these are going to alleviate the air pollution problem and the solid-waste disposal problem, they should be designed to compact refuse to a density of 1800 lbs per cu yard. Present indications are that compactors are being installed with as little forethought as incinerators have been in the past.

27972

Okubo, Shigeyuki

INCINERATOR. (Jinai shokyakuro). Text in Japanese. (Assignee not given.) Japan. Pat. Sho 45-8394. 2p., March 25, 1970. (Appl. July 30, 1966, claims not given).

A three-chamber incinerator is described that permits the odorless combustion of garbage and similar water waste. From top to bottom the chambers are a heated air outlet chamber, a burner chamber, and an incinerator chamber. The incinerator and burner chambers are separated by a lattice rostrum through which the burner chamber is able to dry and complete the combustion of garbag as it passes through a hot air circulation channel, located between the inner and outer walls of the incinerator, to the hot air outlet chamber. Odorous gases generated in the incinerator are passed to a gas discharge pipe and deodorized by water jets prior to their discharge from a tap aspirator.

27986

Alberte, Tony

ENGINE PROGRAMS EXAMINE DIESEL SMOKE, NOISE, ODOR. Diesel Gas Turbine Progr., 37(1):28, Jan. 1971.

The Caterpillar Company is examining several approaches to the smoke control problem of diesel engines from the basic premise that smoke can be reduced only by limiting fuel input or by increasing air input or a combination of both. Work is being carried out on turbocharging, blower turbocharger combinations, and air/fuel ratio controls. An air/fuel ratio control and modified engine combustion system have been installed on a truck. Odor control and noise control activities are also under investigation and will be examined in future issues.

28295

Sugiura, Kimiaki

ODOR POLLUTION. (Midori kagaku no akushu 'Kogai' ni tsuite). Text in Japanese. Preprint, Inst. for Disaster Prevention (Japan), p. 40-41, 1971. (Presented at the Disaster Prevention Chemistry Meeting, 11th, Japan, Jan. 22-23, 1971.)

An investigation made at the request of a hospital identified certain aldehydes and aromatics as the source of objectionable odors issuing from a neighboring pharmaceutical plant. Subsequently, questionnaires were sent to 993 households within a 300-m radius of the plant. Of the 591 households responding, 12% reported the continuous presence of odors, 24.2% the intermittent presence, and 19.5% the occasional presence. An additional 1.4% noted the past occurrence of odors. Following this survey, the prefectural government tested the plant effluent on three occasions and ultimately recommended effluent treatment facilities. The value of the survey is noted to be that it established a relationship between the odor and citizens' complaints, thus entitling the citizens to the right of odor abatement. The plant is now installing an odor control device on its vacuum rotating dryer.

28352

Ainsley, Yvon

POLLUTION CAUSED BY AUTOMOTIVE VEHICLES. (Pollution causee par les vehicules-automobiles). Text in French. Ingenieur, 57e(263): 11-14, Feb. 1971. 5 refs.

Acceleration of a vehicle contributes a higher percentage of carbon monoxide (83%) and of nitrogen oxides (89.3%), while deceleration contributes the highest amount of unburned hydrocarbons. (50.2%). A vehicle not equipped with an antipollution device gives off about 0.64 tons per year of carbon monoxide when driven 7000 miles. Pollution due to unburned hydrocarbons comes from 3 sources. Hydrocarbons passing through the combustion chamber and into the exhaust account for 60%, while blow-by gas accounts for about 20%, and another 20% escapes by evaporation from the gas tank and carburetor. This can add up to a total of 1500 ppm of emissions, or 0.12 tons annually, with a mileage of 7000 miles, when the vehicle is not equipped with an antipollution device. The annual emission of nitrogen oxides amounts to about 0.047 tons. Automobile manufacturers are making available, to the owners of older cars, a device, costing about $50, which reduces carbon monoxide and hydrocarbon emissions by about 40%. It has been shown by tests in the United States that hydrocarbons can be reduced by 10% and carbon monoxide by 16% by a proper adjustment of the carburetor. Automobile dealers must be equipped with devices for reading the emissions of CO and hydrocarbons with instruments, so that it will no longer be necessary to make carburetor adjustments by the 'sound' of the motor. A device for diesel vehicles, to be made available in 1971, would permit reduction of undesirable odors in the diesel exhaust. The use of diesel automobiles should be recommended, especially by vehicles, such as taxis, that are used entirely in town. The development of vehicles that burn natural gas and propane would also reduce pollution levels. The planning of roads is also an important factor in pollution. Road beds that are below the level of the ground, or highways flanked by tall buildings on both sides hinder the dispersion of pollutants, increasing their danger.

28527

Hoshika, Yasuyuki, Tomohiko Ishiguro, and Yoshihiro Shigeta

ANALYSIS OF ODOR COMPONENTS FROM FEATHER RENDERING PLANTS. (Feza kanetsu shoriji ni hassei suru gasu seibun no bunseki). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1): 99, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 10th, 1970.)

An analysis was made of the odorous gas emitted in the feather-meal heating process. For heating at 200 C, reaction with an organic qualitative reagent showed that the gas is positive for 2,4-dinitrophenylhydrazine, H.CHO-H2SO4, fuchsine sulfur dioxide reagent, and CH3COCH3 - KMnO4 tests. The central organoleptic radical was estimated to be unsaturated bondings (aliphatic or aromatic) and aldehydes. Gas chromatography of sample gas concentrated by liquid oxygen showed that the central substance contain acrolein and CH3SH, CH3CHO, CH3CH2CHO, and n-C3H7nH2.

28614

Okamoto, Yoshihiko and Norio Asakura

SURVEYS OF ENVIRONMENTAL POLLUTION EXHAUST GAS IN OSAKA CITY. PART I. (Osaka shinai akushu haigasu chosahokoku). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1): 228, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

The obnoxious odor of white smoke emitted from an autoparts foundr was investigated. White smoke is produced when molten iron is poured into moulding sand containing linseed oil and powdered tar-pitch as moulding agents. The lack of a hood on top of the cooling line had contributed to excess emissions of smoke. Source sampling was done with a high-volume air sampler. In addition, samples were collected 10 cm above the smoke source by means of three large baffles and 6% sodium carbonate solution. The solution turned yellow and upon cooling became a gel such as soap water. Water from the scrubber tower was also collected once every day for a week. To measure particle size, cascade impactors were placed at the top of the cupola and the cooling line, where over 50 of the separated particles were about 2.2 micron, and at the cupola ceiling, about 0.55 micron. The particles were mostly ferric oxide.

28861

Essenhigh, Robert H. and Ta-jin Kuo

DEVELOPMENT OF FUNDAMENTAL BASIS FOR INCINERATOR DESIGN EQUATIONS AND STANDARDS. Pennsylvania State Univ., University Park, Combustion Lab., Contract 5R01 AP00397, TR. FS/PHS 8/69-4, 45p., Aug. 1969. 42 refs. (Presented at the Industrial Waste Conference 3rd Mid-Atlantic, 1969.)

A review of existing standards for construction and operation of incinerators indicates two potentially important emissions. There is no requirement for minimum combustion intensity (though there is for maximum), or alternatively for minimum overfire jet momentum to ensure adequate mixing and maintenance of proper overfire combustio Neither is there any requirement for control of bed depth. Though generally less important than overfire air pressure, improper depth control can lead to intense smoke generation at one extreme, or to chanelling and underfire air bypass with excessive grit pick up at the other extreme. The analysis and discussion includes a general qualitative description and incipient physical model of combustion processes in an incinerator, with some components of the model also quantified, notably the combustion intensity and burning rates in the bed. Alternatively, the problem is represented in terms of control, that is: smoke and odor control- achieved by complete combustion, good mixing, and low excess air; grit control-assisted by low bed and settling chamber velocities, and completed by stack gas cleaning; slag control- affected by underfire air rate, wall composition, and degree of cooling; waste water quality control; and operational control, which becomes possible with adequate instrumentation. (Author summary modified)

28885

Douglass, Irwin B. and Lawrence Price

SOURCES OF ODOR IN THE KRAFT PROCESS. II. REACTIONS FORMING HYDROGEN SULFIDE IN THE RECOVERY FURNACE. TAPPI, 51(10):465-467, Oct. 1968. 9 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Annual Meeting, 52nd, New York, Feb. 19-23, 1967.)

The production of hydrogen sulfide during pyrolysis in the kraft pulping process was studied in the laboratory by heating inorganic substances assumed to be present in the black liquor at 600 C, first with soda lignin and then with glucose. In experiments using sodium sulfate and sodium sulfite, negligible amounts of hydrogen sulfide were formed. In experiments with elemental sulfur, sodium sulfide, and sodium thiosulfate, however, heating with soda lignin or glucose caused 30-75% of the inorganic sulfur to be converted to hydrogen sulfide. These result clearly indicate that large volumes of hydrogen sulfide are formed in a recovery furnace. If conditions for combustion are optimum in the furnace, this hydrogen sulfide will quickly burn to sulfur dioxide and water. The former will react with the alkali in the incoming black liquor and be retained. If the furnace is not operated properly, the hydrogen sulfide can escape to the atmosphere to become a major cause of air pollution. (Author abstract modified)

29332

Hiraike, Makoto

GARBAGE INCINERATOR. (Jinkai shyokyaku sochi). Text in Japanese. (Kawasaki Heavy Industries (Japan)) Japan. Pat. Sho 43-27320. 2p., Nov. 25, 1968. (Appl. Feb. 8, 1965, claims not given).

This invention is a modification of another incinerator, (Japan. Pat. Sho 39-35987) that suffered from highly odorous low temperature exhaust gas and other problems. To eliminate those defects the low temperature exhaust gas from the outlet of the crusher-drier is led into a supplementary incinerating chamber provided in the smoke duct of the incinerator, which is heated to a high temperature. Organic materials and heavy oils are burned in this supplementary chamber. The steam is eliminated in the form of vapor. Thus odor is eliminated and the exhaust gas is led into a simplified wet-type dust collector before discharge to the atmosphere. Wet and odorous garbage is completely incinerated. The incinerator is suitable for industrial use.

29353

Higginson, A. E.

THE DISPOSAL OF REFUSE BY INCINERATION. Public Cleansing (London), 61(3):100-117, March 1971. (Presented at the National Society for Clean Air Conference, Southport, England.)

Most municipal incinerators burn a mixture of domestic, commercial, and some industrial refuse which produce pollutants. The amount of pollution depends on the nature and proportion of any special wastes, the efficiency of the combustion process, gas cleaning techniques, and the dispersal height of the chimney. The combustio of plastics produces pollution in the form of dark smoke and odor. Two major kinds of plastics are thermoplastics which can be heated and softened repeatedly and thermosetting that can be moulded only once. The most important incinerator statutes are provisions of the Clean Air Acts of 1956 and 1968 which deal with the control rate of emissions of dark smoke, grit, and dust from the combustion process. Other aspects are covered under the Public Health Act of 1939 and the Alkali Works Regulation Act of 1906. Noise can also be a pollutant; the recommendations of the Wilson Committee can be used as standards. Stack height can effect the dispersion of dust and gas. Mathematical formulae have been devised to calculate the plume rise, wind speed, and effect on ground level pollutant concentration, but geophysical factors must also be used. The Civic Amenities Act of 1967 controls the disposal of bulky waste. Its size may cause problems and require additional manual attention or shredding. When burning bulky waste, care must be taken in charging the incinerator, temperature and turbulence must be sufficient, and ample oxygen is required. Industrial and sewage sludge can be odorous and difficult to dispose. Factors such as the waste calorific value, weight, moisture content, and volume must be known to properly build and use an incinerator. Gas cleaning can be achieved by electrostatic precipitators, scrubbers, and cyclones. Some standards, instrumentation, and costs are also discussed. Another problem is the disposal of fly-ash which remains after incineration. All waste and sewage is potential raw material for organic humus and inorganic land fill.

29455

Takamatsu, Yoji

INCINERATOR. (Jinkai shokyakuki). Text in Japanese. (Assignee no given.) Japan. Pat. Sho 38-5387. 2p., May 8, 1963. (Appl. Jan. 17 1961, claims not given).

The incinerator described uses an inclined fire rostrum or grate made up of water pipes to produce hot water with the heat of the incineration and to cool the rostrum with water and avoid overheating from the high temperatures that may occur in such a down-draft furnace. The furnace is oblong and the inclined rostrum or grate is located in the lower part of the combustion chamber, with the ash discharge port below the rostrum. The vertical stack or chimney opens into the lower part of the combustion chamber and at about the same level with the rostrum. The lower half of the stacks is surrounded with a hollow double-pipe tube, the lower half of which is buried in the furnace. Above and outside the furnace is a water tank connected to the rostrum. The rostrum pipe closest to the stack is connected to the hollow double-pipe tube which in turn is connected to the water tank by a hot water pipe. Between two air inlet pipes on the top of the furnace is a lidded garbage feed-in port. Combustible trash and solid wastes are first thrown in and burned; the feed-in port is then closed. As combustion progresses, air enters from above and flames and smoke run downward under the rostrum, then ascend upward through and out of the stack. Water running through the rostrum pipes and the double-pipe tube is thus heated. As more garbage is thrown, to make a red hot carbon layer is formed which can rapidly evaporate the water content of water kitchen garbage. When contacted with the red hot carbon layer, the steam produced by the evaporation and mixed with the air becomes semi-watered gas which raises the furnace temperature to about 800 C, high enough to melt glass and deodorize fuel odors.

29599

Okuno, Toshihide, Masahiko Tsuji, and Kokei Takada

PROBLEMS OF PUBLIC NUISANCE CAUSED BY BAD ODORS IN HYOGO PREFECTURE. (Hyogo kenka ni okeru akushu kogai no mondaiten). T in Japanese. Hyogo Prefecture, Kobe (Japan), Environmental Science Inst., Rept. 2, p. 18-24, Feb. 1971.

Hyogo factories which generated bad odors included fish bone and waste treatment plants, oil and fat manufacturing, petroleum refineries, nitrogenous superphosphate of lime manufacturing plants synthetic resin processing plants, and sewage treatment plants. The odorants were amine ammonia, low fatty acids, sulfur compounds, including mercaptan and hydrogen sulfide, olefin, paraffin hydrocarbons, and polycyclic aromatics. In a nitrogenous superphosphate of lime fertilizer manufacturing plant, most odors were produced during the processing stages where the nitrogenous superphosphate of lime completely matured in the reactor, was taken out, was carried over to the dryer by a belt conveyor, and was dried. The odorants of the matured superphosphate of lime in the stock room were aldehyde (0.04-0.63 ppm) and amine (0.004-0.252 ppm). The quantity of the aldehyde and amine varies with the amount of ammonium sulfate added and with the heating temperature. When measured under weather conditions of 15 C and wind velocity of 1-2 m/sec, the density of the aldehyde was 50-200 ppb at a spot 500 m away and 240-460 ppb 100 m away, while the amin was 100-150 ppb and 150-210 ppb respectively. The lowest odor producing density was 0.066 ppm for acetaldehyde and 0.7-0.4 ppm and 1.0-0.8 ppm for n-butylamine. Thus, the odor can be smelled as far away as 1400 m, depending on weather conditions. A fish bone and waste processing plant and a synthetic resin processing plant were similarly studied. Since the odor-producing substances are discharged at various stages of the production process, it is difficult to lead all the odorants into an odor treatment device. It is also economically impractical to seal or encase the entire building and then treat all the air in the building. The lowest odor producing density of the odorants is very low, indicating the technical difficulty of the deodorization. Also, it is doubtful that the problem can be solved by increasing chimney height. A possible solution is a sealed plant equipped with both a continuous scrubber to wash the exhaust gas and chemical treatment or a Cottrell system.

29698

Smoyer, John C., Donald E. Shaffer, and I. Lee DeWitt

A PROGRAM TO SAMPLE AND ANALYZE AIR POLLUTION IN THE VICINITY OF A CHEMICAL RECLAMATION PLANT. Inst. of Environmental Sciences, Mt. Prospect, Ill., Proceedings of the Institute of Environmental Sciences Annual Technical Meeting, 17th, Los Angeles, Calif., 1971, p. 339-345. 5 refs. (April 26-30.)

A preliminary survey of the air pollution in a valley surrounding a reclamation plant was requested by the State of Maryland, which had been receiving complaints from local residents about unusual odors and illnesses for several years. The odors appeared strongest near the plant, which processes mixtures of liquid solvents. Although the odors appeared complex in nature, they could be classified in two general categories: a highly disagreeable and nauseating odor; and an ethereal, or fragrant, odor characteristic of some ketones and alcohols. Air samples were obtained in stainless steel tubes and transported back to the laboratory for analysis. Pollutant concentrations were determined in a Hewlett Packard Model 810 Research Chromatograph equipped with a dual flame ionization detector head. The pollutants were identified by infrared and mass spectrometry. At least 16 compounds, not including carbon monoxide, nitrogen, and water vapor, were detected in the valley air during four sampling periods. The highest concentration detected was 94 ppm of methyl ethyl ketone. (Author summary modified)

29842

Okuno Toshihide and Masahiko Tsuji

SOME PROBLEMS ON THE OFFENSIVE ODOR IN HYOGO PREFECTURE. (Hyogo-kenka ni okeru akushu kogai no mondaiten). Text in Japanese. Hyogo-ken Eisei Kenkyusho Kenkyu Hokoku (Rept. Environ. Sci. Inst. Hyogo Prefect.), no. 2:18-24, March 1971.

Problems of odor pollution Hyogo Prefecture were investigated. The composition of the offensive odor was roughly classified into amine and ammonium compounds, fatty suboxides, mercaptan sulfur compounds such as hydrogen sulfide, olefinic and paraffinic hydrocarbons, polycyclic aromatic compounds, and other organic acids. The chief sources of the offensive odor were fish processing factories, factories using nitrogen-containing superphosphate of lime, and factories producing synthetic resins. It is difficult to introduce the components of the offensive odor into the disposal equipment. A closed system to treat the exhaust gas by continuous washing should be employed. Absorption, burning, and pharmaceutical treatment are additional control techniques.

30218

Tichatschke, J.

STUDIES OF THE EMISSIONS FROM REFUSE INCINERATORS. (Untersuchungen ueber Emissionen aus Muellverbrennungsanlagen). Text in German. Mitt. Ver. Grosskesselbesitzer, 51(3)219-223, June 1971. (Presented at the VGB - Fachtagung Muellverbrennung 1970, Salzburg, Austria Aug. 28, 1970, Hamburg, West Germany, Sept. 11, 1970, and Koln, West Germany, Sept. 25, 1970.)

In an experimental refuse combustion furnace, with a throughput of 20 t/hr at a heating value of 1600 kcal/kg, measurements of the gaseous emissions were taken over a three year period with an electrically heated quartz probe and a subsequent electrically heated quartz wool filter. The sampling point was at the boiler end after the economizer. The waste gas temperature at this point was 220 C. For determination of sulfur trioxide, absorption in 80% isopropanol and photometric methods were used. Sulfur dioxide was absorbed in an iodine solution. Prior to this method, the gravimetric method was used. The chloride content of the flue gases was determined with the mercury(II)-oxide-cyanide method. For this purpose, 50 to 100 liters of flue gas were drawn through a scrubber. For hydrogen fluoride measurements 500 liters of flue gas were drawn through a fritted gas scrubber. Diluted sodium lye was used as absorption solution. The volatile organic acids and aldehydes were also determined. The hydrogen chloride, hydrogen fluoride, and sulfur dioxide concentrations rose gradually over the years. For HCl, a maximum concentration of 18 mg/cu m was measured. For SO2, the frequency maximum ranged from 0.8 to one g/cu m. The most frequently measured SO3 concentration was 0.03 g/cu m. For CH3COOH, a maximum concentratio of 120 mg was measured, and for HCHO, of 200 mg/cu m. The ammonia content, which was measured over a period of two years, ranged from 0.5 to 4.5 mg/cu m. No hydrogen sulfide, chlorine, or phosgene could be detected. The odor of the gases became more pronounced as the temperatures dropped to below 650 C. Rain water samples taken just beneath the smoke plume from an incinerator revealed that the rain is influenced by the waste gas, but is not a concentrated acid.

30327

Engstrom, Staffan

THE STEAM CAR WHICH ALMOST SUCCEEDED. (Angan som nastan dog). Text in Swedish. Tek. Tidskr., 101(3):40-42, Feb. 1971.

Some type of steam-propelled land mobile has been on the market since the 19th century. The Stanley Company, which produces the Stanley Steamer, was one of only 126 steam car manufacturers but was the most successful. The Stanley Steamer made its debut in 1899, and 200 cars were sold that year, and in 1910 there were 2500 sold, for a price ranging from $2800-4000. In 1906, a specially built Stanley broke the then world's record by traveling at 205 m/hr (127 mph). The disadvantages of the Stanley included the unpleasant odors, the noises, the dangers to visibility caused by clouds of steam emitted, and the 45-minute warmup time required. It also consumed an inordinate amount of water: 1.8 liters (0.75 gallons) per mile. An old-style steam car with greater prospects of success was first built in 1912. The company planned to build 10,000 chassis per year, and there were 11,000 orders for the cars, but the U. S. War Emergency Board declared this venture unnecessary to the war effort, and by the end of World War I there were difficulties in reviving plans for mass production. The Doble car required only 500 rpm to attain a speed of 50 km and did not require a transmission. The 1920 model could be accelerated from 0 to 75 mph in 10 seconds. After the 1929 Depression, Doble moved to Germany and continued to make improvements on his steam car. In 1951 he began collaborating with Robert McCulloch in the design of a sports car, but the project was abandoned in 1954, possibly because it was impossible to raise the 50 million dollars needed to initiate mass production.

30389

Carlsson, Bernt-Olof

ENVIRONMENTAL HYGIENE PROBLEMS ASSOCIATED WITH BROILER PRODUCTION. (Arbets- och omgivningshygieniska problem vid broilerproduktion). Text in Swedish. Nord. Hyg. Tidskr. (Stockholm), 52(1):22-31, 1971. 22 refs.

A survey of environmental problems associated with poultry production has been conducted. Poultry production gives rise to dust that originates from feathers, manure, fodder, and litter. Inhalation of dust of similar origin has been reported to cause pulmonary diseases. Ammonia is formed from the anaerobic degradation of manure. Relatively high concentrations of dust and ammonia were found in the work environment, nine to 17 mg/cu m and 10-50 ppm, respectively, particularly during the last part of the breeding period and during cleaning of the chicken houses. Some means to reduce the concentrations of dust and ammonia are recommended, including an alternative performance of the ventilation system and new work methods. It is important that the contents of chemical disinfectants be declared by the manufacturers. The solid waste management may sometimes cause problems. The development of methods for reuse of the waste that has a high nutritive value as a fodder component is recommended. The proper location of the breeding units can help to control the odor problem. Some water pollution may arise from the slaughterhouse due to waste blood. This can be avoided by separate collection of the blood. (Author summary modified)

30513

Kobaysshi, Yoshitaka

ENVIRONMENTAL POLLUTION PREVENTION MEASURES IN FACTORY. (Kojo ni okeru kogai boshi taisaku). Text in Japanese. Preprint, Safety Engineering Assoc., Tokyo (Japan), 22p., 1970. (Presented at the Association of Safety Engineering Seminar, 19th, Yokohama, Japan, Nov. 26-27, 1970.)

Various forms of environmental pollution for which industrial activities are primarily responsible are discussed, including the results of a survey of measures taken by 2512 plants to combat industrial pollution. With regard to air pollution, several major cities in the U. S. are compared with Tokyo in terms of sulfur dioxide, hydrocarbon, oxidant, carbon monoxide, and nitric oxide. Sources of industrial pollution are tabulated to indicate types of air pollutants discharged from particular branches of industry; for instance, SO2 from power generation, iron and steel manufacturing, oil refining and petrochemical operations. Of the 2512 plants surveyed in February 1970, only 1089 attempted to check industrial pollution. Antipollution measures being taken by representative firms are also listed by individual firms. The effects of sulfur oxides on human health is shown by a graphic representation of the case of Yokkaichi asthma; according to the graph, significant health effects are seen when man is exposed to air with an SO2 density of even less than 0.02 ppm for about a year, or to air with 1.0 and 2.0 ppm SO2 for a few minutes. The atmospheric density of CO (ppm) and rate of carboxyhemoglobin in blood (%) are discussed in relation to human health. A table of chemical substances with their critical density for offensive odors is given as well as a diagram indicating lead density by month in relation to rainfall and wind velocity. Another diagram indicates photochemical process in an experimental case and still another shows the relationship between lead density and cadmium density in the atmosphere.

30603

Hind, C. J.

AIR POLLUTION THROUGH EXHAUST GASES. (Umweltverschmutzung durch Auspuffgase). Text in German. Antriebstechnik, 10(3):104-105, March 1971.

Motor vehicles is operation in Great Britain used 4.79 million tons Diesel fuel and 13.2 million tons gasoline in 1969. If all gasoline engines were converted to Diesel engines, the emission of carbon monoxide would drop from 6.1 to 0.3 million tons, that of carbon dioxide would increase from 15.8 to 17.8 million tons, hydrocarbons would increase from 0.48 to 0.56 million tons, aldehydes would be reduced from 0.25 to 0.16 million tons, and sulfur dioxide emission would increase from 0.05 to 0.08 million tons. The differences are due to the circumstance that in contrast to the internal combustion engine, the Diesel engine never chokes the intake air; engine output depends on direct regulation of the quantity of fuel injected into the cylinder. Diesel fuels are lead-free. British medical authorities claim that no evidence exists that Diesel exhaust gases present a health hazard or that they are carcinogenic, even in case of vigorous smoke emission. Smoke and odors characteristically emitted by Diesel engines are a nuisance but not a hazard. In Europe, there are no two countries that would have identical or even comparable Diesel emission limiting regulations, partly because of the difference in testing procedures. A British norm promulgated in 1967 (BS/AU 141) is the strictest of all European norms stipulated maximum permisslbe smoke emission levels for a defined number of revolutions. But the norm has a weak point: it is applied to new vehicles but not in periodic compulsory automobile inspections. Standardization of testing procedures for all of Europe is highly desirable.

30687

Hayashi, Miyoko and Satori Hayashi

ENVIRONMENTAL POLLUTION CAUSED BY PROCESSING POLY VINYL CHLORIDE RESIN. (Enkabiniru jushikakokojo no haigasu to kogai). Text in Japanese. Osaka-furitsu Koshu Eisei Kenkyusho Kenkyu Hokoku, Rodo Eisei=Hen (Proc. Osaka Public Health Inst., Ed. Ind. Health), (7):46-55, Sept. 1969. 7 refs. (Presented at the Japan Society of Air Pollution, Annual Meeting, 9th, 1968.)

The exhaust gas components and the efficiency of the exhaust gas washing devices were investigated in two vinyl chloride resin processing plants, A plant and B plant. The conditions necessary for the occurrence of air pollution damage are discussed. The A plant is presently a source of air pollution, however, no marked air pollution damage has been found around the B plant. Gas chromatography was used for the analysis of exhaust gas components. A characteristic difference between the plants is that a bubbling process is included in the manufacturing process in the A plant. The complaints of the inhabitants living around the A plant were classified in two groups: irritation in the throat and coughing and nausea, vomiting, and headaches. It is believed that the former are due to the fumes of the plasticizer, especially DOP, and the latter are due to the mixed effects of the fumes and decomposed substances, such as DOP. The latter is also the indirect, psychological effect of the offensive odor. The exhaust gas washing device in the A plant, mainly composed of a jet- collector, decreased the concentration of DOP or DBP down to 10%. However, the sensitive effect was not reduced proportionally. Also, the temperature of the exhaust gas is low, therefore, the complaints of the inhabitants have not decreased. Although the results of investigation suggested that the total amount of air pollution is almost the same in the two plants, the damage was found only in the area around the A plant. One reason for this may be that the pollutants are emitted in different ways by the two plants. Also, the B plant is located in a district with severe air pollution damage, so that a new air pollution source cannot be detected.

30701

Weiner, Jack and Lillian Roth

AIR POLLUTION IN THE PULP AND PAPER INDUSTRY. Inst. Paper Chem., Bibliog. Ser., no 237:1-224, 1969. 769 refs.

A bibliography on air pollution is given limited to problems of the pulp and paper industry. A subject and author index are also included. The bibliography includes control methods, measurement methods, analytical methods, odor counteraction, air quality studies, specific pollutants, and so on.

30851

Somers, Joseph H. and George D. Kittredge

REVIEW OF FEDERALLY SPONSORED RESEARCH ON DIESEL EXHAUST ODORS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 39p., 1971. 17 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, June 28-July 2, 1971.)

Projects sponsored by the Air Pollution Control Office over the past years in the field of diesel exhaust odor are summarized. These investigations have concentrated on developing measurement methods for quantifying different odor levels, evaluating various odor control methods, and evaluating public opinions of such odors. A human panel method using odor reference standards has been found suitable to measure these odor levels. In addition to this technique, chemical characterization work has been jointly sponsored by the Coordinating Research Council and the Air Pollution Control Office to isolate and identify those species responsible for the odor. Knowledge of these odorous compounds and the techniques necessary to isolate them should lead to development of a chemical method to measure this type of odor, in place of human panelists. Such basic information would also lead to developing control techniques to minimize this odor. Several control techniques were evaluated for diesel exhaust odor. To date, the only effective method is an improved needle injector for use in the Detroit Diesel type E 6V-71 engine commonly used in buses. Finally, public objections to diesel engine exhaust were measured. A systematic relationship exists between increasing public objections and increasing odor intensity. (Author abstract modified)

31044

Hoshika, Yasuyuki

SOME EXAMPLES OF THE INVESTIGATION OF BAD ODOR CAUSED BY POLLUTION. (Akushu kogai chosa no nisan no jirei). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(1): 28-37, April 1970. 1 ref. See H131-74

Detailed odor measurement studies were conducted on a chemical manufacturing plant, a pharmaceutical plant, and a fish meal processing plant. The raw material, products, production process, place of odor sampling, and degree of odor measured by various methods are listed. The odors included methyl mercaptan, acrolein, dimethyl sulfide, amines, and ammonia. Results obtained by both detector and organoleptic methods are tabulated. Gas chromatograms of odorants from the fish meal processing plant and the pharmaceutical plant are presented, showing the peaks representing the substances.

31155

Maeda, Takeshi

STRUCTURE OF COMBUSTION DEODORING INCINERATOR. (Shokyaku dasshuro no kozo). Text in Japanese. (Aruma Sangyo K. K. (Japan)) Japan. Pat. Sho 46-19386. 3p., May 31, 1971. (Appl. June 12, 1968, 1 claim).

A deodorizing incinerator which has a sharply inclining first wall at the bottom of the partitioning wall facing the burner was described. A second inclining wall slopes down less sharply. On top of the partitioning wall, there is an inlet to dump the garbage in. The upper inside wall of the incineration chamber in front of the partitioning wall is warped. The incinerator is economical, since it combines combustion and deodorizing. When excretion is dumped into the incineration chamber, the flame from the burner is radiated, and air is sucked in by the blower. The matter quickly goes down the first wall, while its water content is removed. It goes down the second inclined wall slowly, burns and falls to the bottom as ash which is discharged as it accumulates. The gas generated in the incineration chamber rises along the curved wall and part of the flame from the burner breaks down the obnoxious odor. The deodorized gas goes through the deodorizing chamber, enters smoke duct, and is discharged. The burner is efficient, inexpensive, and there is no need to operate the whole incinerator at high temperature. The waste material can be thrown in continuously. The incinerator is suitable for garbage containing a certain amount of water; there is no wall necessary for the division of the flame from the burner; and it is easy to maintain and operate.

31157

Maeda, Takeshi

COMBUSTION DEODORING DEVICE. (Shokyaku dasshu sochi). Text in Japanese. (Aruma Sangyo K. K. (Japan)) Japan. Pat. Sho 46-19156. 3p., May 28, 1971. (Appl. June 12, 1968, 1 claim).

A combustion and deodorizing device which burns and disposes of organic matter such as excretion was described. When excretion is burned in an incinerator, there is very little residue. However, there is an obnoxious odor which causes air pollution. The burner is tilted at a 10-35 deg angle, so that a part of burner s flame is directed toward the passage of burning gas, and combustion and deodorization can be carried out by one burner. Inside the incinerator, there is a partition where the combustion chamber is located. The burner is placed opposite the partitioning wall. Outside the opening of the partitioning wall, there is a smoke duct, and the combustion gas generated in the combustion chamber whirls round, flows to the opening of the partitioning wall, and part of the burner s flame is radiated toward this stream of gas to deodorize it.

31263

Hoshika, Yasuyuki

SOME EXAMPLES OF THE INVESTIGATION OF BAD ODOR CAUSED BY POLLUTION (CONTINUED). (Akushu kogai chosa no nisan no jirei. (Tsuzuki)). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(2):19-23, June 1970. 27 refs. See H131-73

Questionnaire surveys were conducted concerning bad odors on residents of city S living near chemical plants, of city E also living near chemical plants, and those living near plant N of a pharmaceutical company. Various opinions such as bad smell, get headaches, lose appetite, and complaints from visitors were obtained. Also, the time of day in which the odor is the worst and the accompanying meteorological conditions were noted. The types of odorants detected by a gas-chromatograph included methyl mercaptan and sulfides. Odor thresholds are presented for hydrogen sulfide, ammonia, and methyl mercaptan according to different methods of measurement, and a tabulation is shown for the amount of odor detected by detector tube, gas-chromatography and organoleptic methods for odors emitted from an amino acid manufacturing and a fish meal plant.

31323

Sherwood, P. T. and P. H. Bowers

AIR POLLUTION FROM ROAD TRAFFIC--A REVIEW OF THE PRESENT POSITION. Ministry of Transport, Crowthorne (England), Road Research Lab.; Ministry of Transport, Crowthorne (England), Earthworks and Foundations Section; Ministry of Transport, Crowthorne (England), Climate Section, RRL Rept. LR 352, 28p., 1970. 28 refs. NTIS: PB 196744

To provide a basis for assessing the needs for further research into the problem, the present position in Great Britain concerning air pollution from traffic is presented. Carbon monoxide, oxides of nitrogen, lead compounds, smoke, unburned fuel and secondary products produced from the fuel, and various particulate matter are cited. None of the major components of air pollution from traffic has been identified in concentrations large enough to be considered to have a more or less immediate and permanent effect on health, though some temporary effects may be present. There may, however, be temporary effects that affect behavior and there is no doubt that smoke and smell from traffic are unpleasant. Consideration should be given to these two aspects to find the extent of the problem so that the value of emission controls can be assessed. Methods of reducing emissions from road vehicles are discussed, as well as the legislation in force for controlling emissions in other countries. If controls of invisible emissions are introduced in Great Britain, it will be necessry to establish whether the legislation is having any effect. There will, therefore, be a need for a rapid method of assessing whether a vehicle complies with the law and for monitoring the levels of pollutants in the air. (Author abstract modified)

31602

Sutton, G. P.

ODORS AND AIR POLLUTION FROM THE TREATMENT OF MUNICIPAL WASTE WATER. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 35p., 1971. 13 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-103.)

The principal effects, causes, and types of odor, their major sources and common treatment methods in municipal waste water treatment were summarized. There is an effect on the neighboring community and also a potentially serious health effect because pathogens from the sewage can be carried by air currents some distance away from the waste water treatment plants. Odors originating from waste water treatment can be grouped into several different categories: gases from anaerobic biological processes, gases originating from certain types of algae, flow-off gases from high temperature pressure cooking processes, gases from the incomplete or improper oxidation or combustion of sludges in incinerators, evaporation of gases from exposed screenings, and poor housekeeping or poor plant operations. Four different types of sewage treatment plants are described, each of increasing complexity and treatment capabilities. In each of the flowsheets of the plants, the specific locations were odors can be generated are identified. Twelve different techniques for controlling, minimizing, or preventing odors from being generated or dissipated are described. They include the prevention of uncontrolled anaerobic conditions, the prevention of algae or microorganism formation, confinement of odors, chemical treatment of waste water, treatment of collected gases, biological treatment of odorous gases, radiation treatment, activated carbon, combustion, electrolysis treatment, masking or counteracting, and dilution of gases.

31759

Lear Motors Corp., Reno, Nevada

A REALISTIC EVALUATION OF THE AIR POLLUTION PROBLEM AND THE SUPPORTING MATHEMATICAL ANALYSIS. 37p., 1970 (?). 9 refs.

Primary sources of air pollution are electric power plants and space heating, industrial plants, and automotive vehicles. The concentration and composition of pollutants vary with the size and area of a population center, with the industry surrounding it, and with climatic conditions. Carbon monoxide and nitrogen oxides are generally found in high concentrations in all major cities of the United States. Health hazards due to air pollutants were discussed. Carbon monoxide interferes with the capacity of blood to transport and release oxygen to the tissues. This interference can impair vision and psychomotor performance. The precise effects of hydrocarbons are not so well known. Some hydrocarbons interact with nitrogen oxides in sunlight, producing odorous smog, eye irritation, and vegetation damage. Nitrogen dioxide is directly toxic to man. Sulfur dioxide is linked with respiratory ailments, asthma, pneumonia, and emphysema. As far as utilities and heavy industries are concerned, stringent policies are being pursued to reduce their contributions to the air pollution. These policies prohibit the use of high sulfur content fuels, shift to natural gas as a fuel when weather inversions threaten, and the use of electrostatic precipitators for chemicals and particulates. The situation of automobile emission appears to be going from bad to worse because of the increasing number of cars and the little or no progress made so far in reducing the emission of pollutants. Federal emission control standards were issued. But there is no assurance that the automobile industry will meet the standards. Alternatives to the internal combustion engine include a steam power propulsion system, electric battery propulsion system, and electric fuel-cell propulsion system.

31880

Steigerwald, Bernard J. and A. H. Rose

ATMOSPHERIC EMISSIONS FROM PETROLEUM REFINERIES. A GUIDE FOR MEASUREMENT AND CONTROL. Public Health Service, Cincinnati, Ohio Div. of Air Pollution, PHS Pub.-763, 56p., 1960. 11 refs. NTIS: FB 198096

The process of petroleum refining and atmospheric emissions from oil refineries were discussed. General information on the processes and equipment used in oil refineries to manufacture petroleum products was given. Crude oil distillation, conversion by cracking, catalytic reforming, polymerization, alkylation, isomerization, treatment with hydrogen and chemicals, and blending were also briefly described. Sources of emission from oil refineries include storage tanks, catalyst regeneration units, pipeline valves and flanges, pressure relief valves, pumps and compressors, compressor engines, cooling towers, loading facilities, waste water separators, blowdown systems, boilers, process heaters, vacuum jets, sampling, air blowing, and acid treating. The main emissions are sulfur oxides, nitrogen oxides, hydrocarbons, carbon monoxide, and malodorous materials. Lesser emissions include particulates, aldehydes, ammonia, and organic acids. The most important factors affecting refinery emissions are crude oil capacity, air pollution control measures, general level of maintenance and good housekeeping in the refinery, and the processing scheme employed. The estimation of atmospheric emissions from oil refineries was demonstrated.

31882

Blokker, P. C.

AIR POLLUTION BY THE OIL INDUSTRY. (Luchtbezoedeling door de olie-industrie). Text in Flemish. Meded. Vlaam. Chem. Ver., 32(6):203-212, Nov./Dec. 1970. 14 refs.

The main potential sources of air pollution from the petroleum industry, excluding the petrochemical industry, are given. The emissions are compared with those from power stations, domestic fuel, and motor traffic. Emissions of nitrogen oxides, hydrocarbons, carbon monoxide, and particulates from the petroleum industry are low in comparison with those arising from other sources. The industry's most important pollutants are sulfur dioxide and odorous gases. Dispersion from high stacks is often an effective means of solving local pollution by sulfur dioxide. For odor abatement, prevention is the best method; examples are given. The problem of abatement cost and norms are briefly discussed. Where health is not impaired, the aim should be a low cost/benefit ratio. The industry is not averse to reasonable norms provided that the level and maintenace are similar in different countries. (Author abstract modified)

32385

Balakrishman, S., D. E. Williamson, and R. W. Okey

STATE OF THE ART REVIEW ON SLUDGE INCINERATION PRACTICE. Resource Engineering Associates, Wilton, Conn., Federal Water Quality Administration Contract 14-12-499, Program 17070DIV, 135p., April 1970. 61 refs.

Consierable development in sludge disposal procedures are taking place and sludge handling and disposal is receiving more attention. Sludge handling and disposal is a costly operation and represents 25 to 50% of the total capital and operating cost of a wastewater treatment plant. It is estimated that the volume of waste sludge will increase 60 to 70% within the next 15 years. Sludge handling processes such as incineration and heat drying require pretreatment of sludge. The pretreatment steps include grit removal, blending, thickening, conditioning, and dewatering. The heat value of sludge depends on the amount of combustible elements such as carbon, hydrogen, and sulfur present in the sludge. When chemicals are used in the pretreatment stage, the weight of the sludge increases by about 10% and, because of their inert nature, the heat content of the sludge is reduced. The various incineration processes are discussed in detail, including their performance and operational problems. Incineration is generally more expensive than other sludge disposal systems. The capital and operating cost of incineration systems depends on the type and size of incinerator, nature and amount of sludge, and whether deodorization, dust collection, and disposal are included. Supplemental fuels are invariably required for sewage sludge incineration, but their requirements flucuate depending on the characteristics of the sludge and are reflected in the operating costs. (Author summary modified)

32411

Boegly, W. J., Jr., W. L. Griffith, and W. E. Clark

ADVANCED SOLID WASTE TREATMENT. In: Annual Progress Report, Civil Defense Research Project. March 1969 - March 1970. Oak Ridge National Lab., Tenn., AEC Contract W-7405-eng-26, 12p., April 1971. 31 refs. NTIS: ORNL-4566, Part 1

The wet-air oxidation of cellulose and paper mixtures, with or without catalysts, was carried out in autoclaves to study solid waste treatment. Off-gases contained no more than a few ppm of organic materials and thus would probably be easily decontaminated by charcoal. The trace quantities present were always detectable by odor, though not always by the analytical methods used (lower limit approximately 10 ppm as methane). The only major off-gas constituents (except nitrogen and oxygen) were carbon dioxide and carbon monoxide. In some cases, the CO content was negligible. Usually the partial pressure ratio increased with increasing oxidation. In the most extreme case, it was less than 0.1. Hydrolysis is the first step in the wet oxidation of cellulose. The products of hydrolysis are then oxidized to CO2 and water, undergo reactions with each other, or are pyrolyzed. Some pyrolysis or other secondary reaction must always take place to produce CO and acetic acid during the oxidation of pure cellulose in excess oxygen. Since the intermediate oxidation products are acidic, they tend to increase the rate of hydrolysis as the reaction processes. Complete oxidation of the products is another problem: the compounds (such as acetic acid) which are responsible for at least 10-15% of the oxygen demand will be difficult to oxidize. A modification of this process will be studied to determine its feasibility in municipal waste.

32465

Gondim, Pedro M.

CONTRIBUTION OF INDUSTRY TO AIR POLLUTION. (Contribuicao da industria para a poluicao do ar). Text in Spanish. Rev. Servico Especial Saude Pub., 16(1):69-91, 1971. 13 refs.

Petroleum refineries, metallurgical processing, and the production of cement are examples of industrial sources of air pollution. These are stationary sources. Mobile sources of air pollution, in particular, the automobile, are becoming an increasing source of problems in urban areas. Automobiles are a product of industry, and industry should be responsible for the control of their emissions. Crankcase and fuel evaporation emissions are under control in the United States, but thermal and catalytic afterburners do not yet satisfactorily control exhaust emissions. In developing countries, such as Brazil, industry is needed, but there are good reasons for also starting an air pollution control program. Pollutants such as sulfur oxides, hydrocarbons, nitrogen oxides, particulates, aldehydes, ammonia, odors, and carbon monoxides are emitted by industry. (Author summary modified)

32475

Japan Environmental Sanitation Center, Tokyo

REPORT OF SURVEY OF THE SPECIFIED POISONOUS SUBSTANCES AND THE PREVENTION OF OFFENSIVE ODOR. REPORT 4. (Tokutei yugaibusshitsu narabini akushu boshi ni kansuru chosa kenkyu hokokusho (Dai 4 po)). Text in Japanese. 67p., Aug. 1969. 14 refs.

The kraft pulp and petro-chemical industries were examined as sources of offensive odors and the actual cotdition of the offensive odor was analyzed. The present state of odorous emissions from these industries, problems, and countermeasures are discussed. The offensive odors produced in the digester process of a kraft pulp industry in Fuji City, Shizuoka Prefecture were measured by a sense organ method, obtained by modifying the odorless chamber. The odors were analyzed by the salt-balanced method, the glass beads tube (selective adsorption of offensive odors), and the low temperature adsorption method (concentration of the odor by liquid oxygen). The volumes of dimethyl-disulfide, hydrogen sulfide, mercaptan, and dimethyl sulfide in the odor were great. Odors analyzed from the recovery boiler in the kraft pulp factories in Miyagi Prefecture contained 1-4 ppm methyl mercaptan, 20-300 ppm hydrogen sulfide, and approximately 1 ppm dimethyl sulfide. The volume of gas emitted at that time was 290,000 cu m. About 1% of methyl mercaptan and dimethyl sulfide was detected from the turpentine tank. Odors from petro-chemical factories in Yamaguchi Prefecture were measured by gas chromatography. The odors were composed of vinyl chloride, 1,3-butadiene, propylene oxide, acetaldehyde, methyl acetate, and ethylene dichloride.

32489

Giever, P. M.

CHARACTERISTICS OF FOUNDRY EFFLUENTS. Preprint, American Foundrymen s Society, Des Plaines, Ill., 3p., 1970. 7 refs. (Presented at the Total Environmental Control Conference, Ann Arbor, Mich., Nov. 16-19 1970.)

Effluents from the numerous types of foundry furnaces and products vary over a wide range of physical and chemical characteristics including visible plumes, particulates, irritating fumes, and gases, as well as explosive dusts. Approximately 90% of the gray iron melting furnaces are cupolas and only 15 to 18% of these have air pollution control devices installed. One of the most important characteristics of cupola effluent is the high temperature. In addition to particulates, the effluent from cupolas contains gases which are primarily carbon dioxide and nitrogen with some excess oxygen and varying amounts of sulfur dioxide. Smoke, oil vapor, and fumes make up the remainder of the emissions. Emissions from electric arc furnaces and non-ferrous foundries are also discussed. These include zinc dust, ammonium chloride, carbon monoxide, carbon dioxide, fumes, sulfur oxides, sulfides, sulfates, metal oxides, aluminum oxides, odors, particulates, and many others. Particle size can be an important aspect.

32653

Donaldson, Wallace R.

AIR POLLUTION BY JET AIRCRAFT AT SEATTLE-TACOMA AIRPORT. Weather Bureau, Salt Lake City, Utah, Western Region, Proj. 2949793, ESSA-WBTM-WR-58, 22p., Oct. 1970. 13 refs. NTIS: COM 71 0017

The air pollution by jet engines at the Seattle-Tacoma Airport is discussed. Air traffic patterns and social factors are also described. Jet aircraft engines emit carbon monoxide, hydrocarbons, oxygenated organic compounds, and nitrogen oxides which vary during operating modes. Engine smoke is composed of fine carbon particles with diameters of 0.6 micron or less. The combination of size and composition gives the exhaust light-scattering properties. Also, the exhaust emits small amounts of aerosols, soots, sulfur compounds, and odors. Comparisons are given of automobile and aircraft engine emissions and of daily contaminant emissions in Los Angeles from motor vehicles, power plants, and jet engines. Studies were made of Air Force commercial engine comparisons, jet aircraft time comparisons, pollution emissions for various operations, local dispersion areas, and area fuel consumption rates. Jet exhaust pollutants can generally be reduced by the addition of smokeless burner cans, but this increases the emission of nitrogen oxides. When fuel additives were used, particulate matter, hydrocarbons, organic gases, and sulfur dioxide decreased, but carbon monoxide and nitrogen oxides increased. The visible smoke plume is an additional problem.

32855

Ishiguro, Tatsukichi, Kazuo Hishida, and Tsunehiro Yajima

PRESENT STATE OF PUBLIC NUSIANCE CAUSED BY OFFENSIVE ODORS IN TOKYO. (Tokyo ni okeru akushu kogai no genjo). Text in Japanese Yosui To Haisui (J. Water Waste), 13(8):972-978, Aug. 1971.

Control criteria were designated for emissions of smoke, gases, and offensive odors in Tokyo. The harmful gases included ammonia, fluorine and its compounds, hydrogen cyanide, carbon monoxide, formaldehyde, methanol, isoamyl alchohol, isopropyl alcohol, hydrogen sulfide, hydrogen chloride, acrolein, acetone, sulfur dioxide, benzene, nitrogen oxides, toluene, phenol, sulfuric acid, and chromic acid. The public Nuisance Bureau received 2751 complaints about offensive odors and 416 complaints about deleterious gases during 1970. The major sources of the offensive odors were plants processing fish guts and bones, animal bones and fat, and feathers, stock yards, poultry farms, urban waste disposal plants, sewage treatment plants, fish oil processing plants, varnish manufacturing plants, lubricant oil regenerating factories, soy sauce lees and other vegetable protein processing plants, organic fertilizer manufacturing plants, and food manufacturing plants. Deodorization experiments were conducted with respect to the analysis of the components of odors, deodorizing devices, sensory tests, interrelation of odor constituents, and process improvements.

32878

Okada, Seisuke

COLLECTED DATA ON ALLOWABLE AND MINIMUM PERCEPTIBLE CONCENTRATIONS OF ODOR SUBSTANCES. (Yushu busshitsu no jintai ni taisuru kyoyo nodo narabini shuki chikaku ninchi genkai nodo ni tsuite no shuroku). Text in Japanese. Yosui To Haisui (J. Water Waste), 13(9):1136-1142, Sept. 1971. 15 refs.

The toxicity of odor producing materials their perceptibility threshold, and recognition threshold are presented in table form, including data on 232 items, compiled from a number of sources. There are approximately 13 substances among the listed elements, including carbon tetrachloride and phosgene for which the threshold values are greater than the maximum permissible concentrations in the human body.

32879

Hoshika, Yasuyuki

ON THE FIELD EXPERIENCE OF ODOR POLLUTION SURVEY METHOD IN KRAFT PULP INDUSTRY. (Kurafuto parupu kogyo ni okeru akushu chosa no genjoteki keiken ni tsuite). Text in Japanese. Yosui To Haisui (J. Water Waste), 13(9):1128-1135, Sept. 1971. 12 refs.

The digesting process, dehydration and scrubbing, black liquor oxidation, evaporation, and recovery boiler operations in Kraft Pulp mills are explained with a flowsheet. The Kraft Pulp Mill in Fuji City was investigated by the olfactory method and the injection method (odor concentration times exhaust quantity) on Dec. 6, 1970. Compared with other odor emission rates of a fishmeal plant complex in Yamaguchi Prefecture, (ten to the 6th power - ten to the 7th power), a fishmeal plant complex in Tokyo (ten to the 7th power - ten to the 9th power), a pharmaceutical plant complex in Tokyo (ten to the 5th power - ten to the 9th power), and a fishmeal plant complex in Yamanashi Prefecture (ten to the 8th power - ten to the 9th power), all the high emission sources being usually contained in one area, the Fuji KP Mill had three locations with more than ten to the 9th power odor emission rate. The ten locations where odor emission rates were taken all had rates between ten to the 7th power - ten to the 9th power. The three locations with high counts were 2K washer, 1K turpentine cooler, and the recovery boiler. A large portion of the emission comes from the stack exhaust gas in the recovery process, and the next largest from the digestion process; the emissions from these two sources amount to two-thirds of the total quantity. The breakdown of the sulfur compounds produced by the Kraft Pulp Mill is: CH_3SH, 500 kg/500 ton pulp; $(CH_3)_2S$ 1500 kg; and $(CH_3)_2S_2$, 50 kg, a total of 2050 kg.

33188

Field, Joseph H.

PRINCIPLES OF CLEANING COMBUSTION PRODUCTS. In: Principles and Practices of Incineration. Richard C. Corey (ed.), New York, Wiley-Interscience, 1969, Chapt. 3, p. 34-73. 54 refs.

In the incineration of waste material, problems often arise from the emission of particulate matter and foul odors. The fundamental principles involved in control devices, including basic particle dynamics, and the principles used in odor control are presented, an understanding of these principles is necessary in evaluating control equipment for a specific incinerator. Cyclone separators, settling chambers, filters, scrubbers, and electrostatic precipitators are reviewed. For controlling or eliminating odors from incineration, dispersal, adsorption, afterburning with or without catalysts, odor modification, and wet scrubbing are employed. Important aspects of these methods of odor control are discussed.

33564

Spindt, R. S., G. J. Barnes, and J. H. Somers

THE CHARACTERIZATION OF ODOR COMPONENTS IN DIESEL EXHAUST GAS. Preprint, Society of Automotive Engineers, Inc., New York, 31p., 1971. 9 refs. (Presented at the Society of Automotive Engineers International Mid-Year Meeting, Montreal, Canada, June 7-11, 1971.)

The chemistry of diesel exhaust odor is discussed. One study separated the exhaust samples into two odor-important fractions and facilitated more complete and comprehensive structure determination. Fuel-like chemical species contributed to the exhaust odor. The aromatic hydrocarbon classes of alkyl benzenes, indenes, indans, tetralins, and naphthalenes were identified. The greatest differences found in two studies were associated with the odor of partially oxidized fuel species. One analysis showed that paraffinic aldehydes were significant odor contributors, while the second suggested that these compounds were present, but were not significant contributors to the characteristic diesel odor. Some of the general classes contributing to the odor were hydroxy and methoxy indanones, methyl and methoxy phenols, furans, alkyl benzaldehydes, alkenones, dienones, and hydroxy cyclocarbonyls. The understanding of the relative contribution of these chemical species to diesel exhaust odor will provide a basis for reduction of diesel odor. (Author summary modified)

33648

Pachernegg, Siegfried J.

EXPERIMENTS WITH THE SINGLE CYLINDER ENGINE FOR DEVELOPMENT OF DIESEL ENGINES WITH HIGH CHARGING AND HIGH RATE OF REVOLUTIONS. (Experimente am Einzylinder-Motor zur Entwicklung von Diesel- mit hoher Aufladung und hoher Drehzahl). Text in German. Motortech. Z. (Stuttgart), 32(10):356-360, Oct. 1971. 7 refs.

A single-cylinder, turbocharged engine was tested on a specially constructed dynamometer to determine its ability to operate at up to 75 hp/l. Combustion was characterized by the face that the first 60-70% of injected fuel burned at the moment of injection while the residual 30-40% required almost twice the time. This had a negative effect on combustion efficiency and resulted in soot formation. With the exception of nitrogen oxides, the emission of unburned components (soot, carbon monoxide, and, to a lesser extent, hydrocarbons) and odors depends on the second phase of the combustion period. Exhaust gas analysis revealed a concentration of 1.5% of unburned or incompletely burned components of the fuel referred to the supplied fuel heat. Therefore, the degree of conversion was 98.5%.

33713

Hilliger, H. G., H. J. Langner, V. Hilbig, and Ursula Heckel

EXPERIMENTS FOR CHARACTERIZATION OF ODOUR STUFFS CONTAINED IN THE AIR OF THE INTERIOR OF A LAYING-HEN HOUSE. (Versuche zur Charakterisierung geruchsaktiver Stoffe in der Luft eines Legehennenstalles). Text in German. Zentralbl. Bakteriol., Parasitenk. Infektionskr. Hyg. Abt. 1: Orig., Reihe B, vol. 155:87-92, 1971. 6 refs. (Presented at the Internationalen Arbeitstagung, Einfluss der Umweltfaktoren in Viehstaellen, Gent/Belgien, Sept. 11-Dec. 12, 1970.)

The air of a hen house was examined for odorous substances, especially carbonyl compounds; 23 different carbonyl compounds were identified chromatographically. Air samples contained an average of 28.6 ppm ammonia and 2.22 ppm total carbonyl compounds, expressed as ethanol. Major carbonyl compounds were methanol, ethanol, and acetone; other carbonyl compounds were present only in low percentages. Until the role of the latter in the development of poultry-house odor is known, they should not be neglected when analyzing odors. A suitable technique for collecting and preparing samples is described.

33719

Stueckrad Joachim and Ulrich Dorstewitz

WHAT DO WE HAVE TO EXPECT? (Was komnt auf uns zu)? Text in German. Umwelt (Duesseldorf), 1(5):35-42, Oct./Nov. 1971. 6 refs.

Most of the pollutants in our atmosphere stem from vehicles, industries, homes, and small businesses. About 20.5 million tons of pollutants were emitted in the year 1970, of which 60% came from the automobiles. This becomes plausible when it is considered that an automobile emits 0.14 to 5.6 cu m of exhaust gas each minute depending on the stroke volume. At the combustion of a fuel quantity of 1000 l, 360 kg carbon monoxide develop, 24 to 28 kg hydrocarbons, 6 to 8 kg oxides of nitrogen, 0.6 to 1.2 kg sulfur compounds, 36g dusts, and other pollutants. Diesel engines and airplanes emit considerably less pollutants than the Otto engines. The most important polluters in the industrial sector are the power plants with 14% of the total pollution, followed by the chemical industry metallurgical plants, coke ovens, incinerators, and the cement industry. The emissions by domestic heating systems are remarkable. Coal-fired heaters emit sulfur dioxide and soot, oil-fired emit odorous gases. Of all the pollutants, CO makes up the largest portion, dusts make up 20%. The anti-pollution measures have gaps, e.g., maximum allowable emission concentrations have not been set up for all pollutants, the study of the synergetic effects is still at the very beginning.

33828

Papetti, R. A. and F. R. Gilmore

AIR POLLUTION. Endeavour, 30(111):107-114, Sept. 1971. 32 refs.

Sources of air pollution are discussed, as well as its distribution, harmful effects, and mathematical modeling. The number and size distribution of atmospheric particles is controlled by the balance between their continual generation, transport, chemical and physical alteration, and removal. The relative importance of gravitational settling and diffusion due to Browni-an motion is discussed. Sources and urban concentrations of the oxides of sulfur are indicated, as well as photochemical smog constituents, carbon monoxide, and metals. The influence of wind, turbulence, and stability on air pollution is discussed. Visibility may be reduced due to aerosols or nitrogen dioxide. Unpleasant odors may result from sulfur compounds. The harmful effects of air pollution that can be treated in simple economic terms include damage to materials, to agricultural crops, and livestock. Physiological effects and health impairment are also discussed. Mathematical models for calculating air quality are considered.

33883

Rayzacher, B.

THE OIL INDUSTRY AND THE ENVIRONMENT. Stichting Concawe, The Hague (Netherlands), Rept. 8/70, 17p., April 1970. 15 refs.

The initial step in oil production, recovery of the crude oil from its natural deposits, does not have any appreciable adverse environmental effects. Transport by ocean tanker, pipeline, and road and river tankers does often cause pollution of the soil, land and surface, and of ground and surface waters. Malodorous emissions during the refining process are complicated by the numerous points, some a considerable distance from the ground, where leakages may occur, and by the human olfactory sense which can detect the presence of some compounds at extremely low concentrations. Good maintenance and constant equipment control are required. Sulfur emissions in the refining process stem from the frequent use of high-sulfur fuels for various plant operations and from flare burn-off. Control methods in the former case include desulfurization and dispersion by tall stacks. Water pollution and noise problems from refining are also discussed. Wrong or negligent use of petroleum products contribute to air and water pollution, but here correction rests to a large degree with the individual user. For example, by correct adjustment of the carburetor and ignition, automotive exhaust emissions can be reduced by up to 50%. The costs of producing unleaded no-knock gasolines, of desulfurizing fuel oils, and of using naturally low-sulfur fuels are discussed.

33983

Wilson, Donald F. and Bjorn F. Hrutfiord

SEKOR IV. FORMATION OF VOLATILE ORGANIC COMPOUNDS IN THE KRAFT PULPING PROCESS. Tappi, 54(7):1094-1098, July 1971. 36 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Annual Meeting, 56th, New York, Feb. 22-25, 1971.)

The formation of steam volatile organic compounds in the kraft pulping process other than the recovery furnace is reviewed. Reaction mechanisms for the formation of hydrocarbons, sulfur compounds, alcohols, and terpenes are determined. The route to the formation of methyl ketones was established as air oxidation of extractives followed by hydroperoxide decomposition to unsaturated ketones which undergo a reversed aldol condensation in the kraft digester. Fermentation was proposed to account for the formation of all the alcohols except methanol. Guaiacol and related phenolic compounds were determined of importance in overall kraft mill odor. (Author summary modified)

34018

Bernhart, A. P.

NOTES ON AIR POLLUTION: THE INGREDIENTS DEFINED. PART I. Water Pollution Control (Toronto), 109(10):41-42, Oct. 1971. 19 refs.

The problem of air pollution in Canada is reviewed with respect to effects on human health (respiratory diseases), animals, plants, buildings (soiling and deterioration), traffic (visibility), and economy; breakdown by individual pollutant; and major sources. The major pollutants and their sources included suspended particulates and dust fall from furnaces, incineration, and cement plants; pollen from grasses and trees; sulfur oxides from coal furnaces; carbon monoxide from cars; hydrocarbons from engine exhausts and gasoline evaporation; aldehydes from diesel exhausts and dry cleaners; nitrogen oxides from power plants; oxidants; odors from slaughterhouses, garment factories, glue factories, and diesel buses; fluorides from aluminum and fertilizer plants; lead from car exhausts; benzopyrene; carbon dioxide; and other minor pollutants, i.e., organic acids, hydrogen sulfide, ammonia, chlorine, and bromine.

34228

Engdahl, Richard B.

ON-SITE INCINERATION OF SPECIAL INDUSTRIAL WASTES. In: Principles and Practices of Incineration. Richard C. Corey (ed.), New York, Wiley-Interscience, 1969, Chapt. 7, p. 210-226. 32 refs.

As a means of controlling air pollution, on-site incineration of special industrial wastes is often advantageous. The worthless, solid, combustible residues from manufacturing processes can be disposed of by the Class III incinerator. Skillful operation is necessary, however, to avoid the discharge of fly ash and smoke. Refractory-lined rotary kilns are also used to burn industrial solid wastes. Conical burners and silo burners have been used to dispose of wood wastes. The silo burner is preferred, since the conical burner tends to emit dusts, cinders, and fly ash. Special incinerators have been developed for burning scrap automobiles. Afterburners are often required to completely burn the combustible gases as they enter the incinerator chimney. Dust collecting systems are required with most methods of solid waste disposal. The incineration of liquid wastes is also discussed in detail. Some effluents contain combustible hydrocarbons; they can be incinerated by direct flame of may be catalytically oxidized. The incineration of gaseous wastes must be complete or products of partial oxidation, such as aldehydes or organic acids, may be discharged. Cost of data are given for direct-flame incineration in several cases of industrial odor and fume problems, and for odor control by catalytic combustion and direct-flame afterburning.

34287

Natusch, D. F. S.

THE EFFECTS, MEASUREMENT AND CONTROL OF HYDROGEN SULPHIDE POLLUTION IN GEOTHERMAL AREAS. Clean Air (J. Clean Soc. Australi New Zealand), 4(4):69-75, Dec. 1970. 13 refs.

New Zealand produces a disproportionate amount of the world s atmospheric hydrogen sulfide because of geothermal activity. Geothermal occurrence of H2S differs from industrial sources in that the gas is produced at ground level from vents and fissures and from the exhaust gases of bores. Besides some odor and health problems, the most widespread effect in geothermal areas from H2S is metal corrosion, and the corrosion of silver and copper components in electrical and electronic circuits constitutes a rapidly increasing problem where H2S is present in concentrations above 0.01 ppm. The probable long-term effects of sulfide corrosion are best assessed by observing susceptible metals present in a given locality for a long period. Measurement and control methods are detailed. Accurate measurements of H2S concentrations in air are best obtained using an impregnated tape method, preferably utilizing silver nitrate tapes. Adequate protection from H2S can be achieved by filtration with activated carbon, provided that certain criteria are observed. (Author conclusions modified)

34290

Murphy, R. P. and J. F. Pottinger

AIR POLLUTION FROM WOOD WASTE INCINERATION. Clean Air (J. Clean Air Soc. Australia New Zealand), 5(2):26-30, May 1971. Presented at the Australian Waste Disposal Conference, New South Wales Univ., Australia, 1971.)

About 70% of wood wastes from timber processing in New South Wales, Australia, are disposed of by incineration, which can give rise to excessive emissions of smoke, odors, ash, and charred particles if not carried out in a properly designed incinerator equipped with adequate pollution controls. Emissions from wood waste combustion are related to the components of wood: moisture, volatile matter, fixed carbon, and ash. Emission data and design considerations are given for refractory incinerators, conical or tepee burners, and wood-fired boilers. Tests were conducted which, together with other evidence indicate that tepee burners in their present form cannot meet the requirements of the New South Wales Clean Air Act, although they are widely used because of their low cost and flexibility. Design improvements are suggested. Successful control of smoke emissions from boilers is possible with secondary air jets. Provisions of the Clean Air Act and government standards for incinerators in New South Wales are reported.

34585

Meuthen, Bernd

WASTE AIR PROBLEMS IN THE COIL COATING INDUSTRY. (Abluftfragen aus der Sicht der coil coating-industrie). Text in German. Staub, Reinhaltung Luft, 31(10):407-410, Oct. 1971. 23 refs.

During the coil coating process, organic gaseous emissions develop. The gaseous emissions are primarily composed of volatilized organic solvents of a known nature, as well as components developing during the reaction of the binding agents and solvents on the hot furnace walls. Such reaction products are marked by annoying odors. According to the present experience, they amount to approximately four percent of the solid content. Type and quantity of the organic emissions are subject to great temporal fluctuations. The fraction of hydrocarbons emitted by such plants amounts to 0.1% of the total hydrocarbon emissions. Regulations in North Rhine Westphalia require cleaning of such waste gases to a residual carbon content of 300 mg/cu m. In other West European countries, no such stringent regulations exist. In the U. S., the use of certain solvents is prohibited and the emission quantities are limited. Catalytic combustion has been used as a control method. But this method is not very suitable because of catalyst poisoning. Thermal afterburning has found little application in Europe, but is the accepted method in the United States. The best solution would be the use of coating material which is free of solvents. Such coating material is available in form of so called power lacquers whose quality has yet to be improved for satisfactory use. A special method of lacquer drying, electron beam curing, is in the developmental stage. With the method, none of the present solvents will cause any emissions.

34654

Haedike, Edward W.

BUILDING A BETTER INCINERATOR. Ind. Gas, 51(11):15-17, Nov. 1971.

Engineers know well the necessity for adequate temperatures in incinerators for clean, smokeless combustion. The need for supplemental heat, and sometimes for furnace preheating, is recognized as a practical solution to the problem of low combustion temperatures. The burnout of smoke is achieved at 1500 F and the oxidation of most odorous compounds is completed at this temperature. The Incinerator Institute of America classification of waste is cited. Commercial fuel gas or fuel oil can be considered for firing incinerators. Modern incinerators are designed to locate the package burner in the side wall and firing into the combustion chamber above the grate level and above the refuse heap. The flame preferably should be of the long and luminous type, so that it may sweep across to all sides of the waste and quickly transfer its radiant heat to the combustion chamber. Sidewall location of the burner, the above grate installation, and a double-chamber incinerator are mentioned. Manual operating control, automatic operating control, thermoelectric control, electronic control, and non-electronic spark are available for use with the burners.

34766

Aaronson, Allen E. and Richard A. Matula

DIESEL ODOR AND THE FORMATION OF AROMATIC HYDROCARBONS DURING THE HETEROGENEOUS COMBUSTION OF PURE CETANE IN A SINGLE-CYLINDER DIESEL ENGINE. Combustion Inst., Pittsburgh, Pa., Symp. (Int.) Combust., (Proc.), 13th, Salt Lake City, Utah, 1970, p. 471-481, 1971. 13 refs. (Aug. 23-29.)

Experimental facilities and methods, based on combined gas chromatographic and mass spectrometric techniques, are examined for the qualitative analysis of odoriferous and carcinogenic compounds formed during the heterogeneous combustion of pure hydrocarbon. Exhaust gas samples from a diesel engine operating on a lean pure cetane-air mixture were analyzed for saturated and unsaturated aldehydes, alcohols, acids, homo- and heterocyclic compounds, and aromatic compounds. The diesel odor problem and potential biological activity of diesel exhaust were examined. The pyrolysis and partial oxidation of lubricating oil blowby enhanced the production of aromatic hydrocarbons. (Author abstract modified)

34891

Springer, Karl J.

BASELINE EXHAUST EMISSIONS FROM U. S. ARMY M54A2 LDS 465 POWERED FIVE-TON TRUCKS. (FINAL REPORT). Southwest Research Inst., San Antonio, Tex., Army Materiel Command Contract DAAD05-67-C-0361–Modification P008, Rept. Ar-690, 36p., April 30, 1969. 14 refs. NTIS, DDC: AD 722832

Baseline exhaust emissions data were obtained as part of a 20,000-mile test of lubricant oils in four M54A2 five-ton Army trucks powered by the LDS 465 turbocharged, four-cycle, compression ignition engine. These emissions included odor, smoke, and chemical/instrumental measurements of total unburned hydrocarbons, carbon monoxide, carbon dioxide, oxides of nitrogen, nitric oxide, total aliphatic aldehydes, formaldehyde, acrolein, and sulfur dioxide using the latest techniques available. Power checks as well as emissions were obtained at the beginning, end, and at about 6500 and 12,000 miles duration. The effects of vehicle operating condition and test mileage are presented as part of the analysis of the results. Typical data for two widely used, commercial truck-tractors powered by four-cycle, naturally aspirated and turbocharged engines are indicated to place the military truck emissions in perspective. Limited back-to-back type operation of two vehicles on a commercial barium smoke suppressant fuel additive was conducted periodically and the constant and transient smoke results are presented. (Author abstract)

34964

ODonnell, A. and A. Dravnieks

CHEMICAL SPECIES IN ENGINE EXHAUST AND THEIR CONTRIBUTIONS TO EXHAUST ODORS. IIT Research Inst., Chicago, Ill., Rept. IITRI C6183-5, 81p., Nov. 1970. 10 refs. NTIS: PB 198072

The nature of odorous species in the exhaust from a Detroit Diesel Engine Division 6V-71N, operated at constant load and fuel conditions, was investigated using high-resolution two column gas chromatography, mass spectrometry on resolved species, and sensory observations. Solid adsorbent collection devices were used to sample from a nitrogen-diluted exhaust stream. Although the presence of many hundred of compounds was indicated by the chromatograms, only a small fraction were found to exhibit distinct odors at concentrations encountered in the exhaust. The major concentration species, the paraffinic hydrocarbons, are individually non-odorous. The odor-relevant species are polar, and many exhibit low odor thresholds, occurring in the exhaust in relatively small concentrations. From mass spectral data, a variety of compound types was found among the more important odor contributors including: aliphatic aldehydes, aliphatic compounds with more that one position of unsaturation, alkyl derivatives of benzene, indan, tetralin, and naphthalene, aldehyde and ketone derivatives of benzene and alkylbenzenes, and sulfur species. Auxiliary gas chromatographic methods suggest that aliphatic acids are also odor relevant. (Author abstract modified)

35383

Keshen, Albert S.

SOLID RUBBER WASTES. Ind. Wastes, 4(1):14-15, Jan. 1959.

A prefabricated steel-framed, brick-lined, two-chamber incinerator incorporating an oil burner in each chamber was used insure complete combustion of rubber wastes at a manufacturing plant. Temperatures from 1600 to 2400 F are maintained by the use of the two oil burners. Because of the heterogeneous nature of the waste, which includes some asphalt products, the usual 2100 F which provides operation free of objectionable smoke and odor. The unit is hand fed with a capacity sufficient to handle over 20 tons of waste daily. Burning is started and maintained in the primary chamber by one of the oil burners. Unburned gases and particulate matter pass to the secondary chamber where they continue to burn. If a sufficiently high temperature is not self-sustaining in this chamber a second burner is provided to carry out complete combustion. The capital investment in the incinerator is about $40,000. 0

35564

Elliott, L. F. and T. M. McCalla

AIR POLLUTION FROM AGRICULTURE. Nebraska Univ., Lincoln, Extension Service; Dept. of Agriculture, Washington, D. C.; and Nebraska Univ., Lincoln, Coll. of Home Exonomics, Proc. Explor. Nebr. Pollut. Probl. Lincoln, Nebr., 1971, p. C-1 - C-6. 29 refs. (April 22.)

The major atmospheric pollutants from agriculture are examined. Dust due to wind erosion and agriculture-related industries (alfalfa mills, lime kilns, cotton gins), allergens from weeds and crops, pesticides, smoke from open burning of crop residues, odors from animal wastes and processing of agricultural products, and gases released by animal wastes (carbon dioxide, carbon monoxide, hydrogen sulfide, ammonia, and methane) contributed heavily to air pollution. Possible control methods include improved tillage practices and cropping methods; electrostatic precipitators and dust filters for industrial usage; weed control programs; controlled spraying; treatment facilities for odor prevention; and chemical control of animal waste odors.

35581

Weiner, Jack and Lillian Roth

AIR POLLUTION IN THE PULP AND PAPER INDUSTRY. Inst. Paper Chem. Bibliog. Ser., no. 237, 67p., 1970. 208 refs.

A bibliography of 208 references and abstracts on air pollution in the pulp and paper industry is presented. Control methods, measurement and analysis techniques, air quality criteria, deodorization, basic chemical reactions, operating procedures, exonomic factors, emission toxicity, meteorological factors, effects on human health and vegetation, defined sources within the industry, control legislation, and technological improvements are examined.

35590

Elliot, Martin A. and Roger F. Davis

COMPOSITION OF DIESEL EXHAUST GAS. SAE (Soc. Automot. Engrs.) Quart. Trans., 4(3):330-346, July 1950. 16 refs. (Presented at the Society of automotive Engineers National Diesel-Engine Meeting, St. Louis, Mo., Nov. 2, 1949.)

The relationship between air/fuel ratio and the products of incomplete combustion is discussed. A relation observed between the concentration of aldehydes and the odorous and irritating character of diesel exhaust gas suggested that removal of aldehydes should reduce both properties. Tests with water as a scrubbing medium showed that aldehydes cannot be removed completely by such a system. However, aqueous sodium sulfite solutions inhibited by the addition of hydroquinone to prevent oxidation of the sulfite removed substantially all of the aldehydes and produced significant reductions in odor and irritation for extended periods of time. The application of data on exhaust-gas composition to the determination of operating and performance data on diesel engines

is discussed and methods of calculation and relevant equations are given. (Author abstract modified)

35599

McCauley, Robert F.

THE PRESENT STATUS OF COMPOSTING AND ITS AIR POLLUTION ASPECTS. J. Air Pollution Control Assoc., 6(4):233-237, Feb. 1957.

Modern composting is an aerobic process in which waste organic materials are ground or shredded and then either piled in windrows or fed into the decks of a digester. Oxygen from the air penetrates into the voids of the material where it dissolves in the liquid moisture films and is carried to aerobic bacterial organisms. In composting, the potential for creating odor and other nuisances is high. The grinding of garbage in fully enclosed areas, unless fully automatic, is most offensive to the workmen conducting the operation. Some ventilation is required; the more the ventilation, the greater possibility of creation of air pollution problems. During the early stages of composting a definite acrid or acid odor is noticeable. Later, the odor becomes musty, and may become extremely objectionable to the inhabitants of the plant area who must be faced with the plant odor for long time periods. Heavy moisture vapors are a serious consideration during periods of cold weather operation. Odor problems can probably be overcome by the use of tall stacks, high-temperature burning of air, and similar processes. However, these devices limit the economic value of composting and will probably have to be avoided if the process is to compete with incineration and other conventional methods. The most hopeful approach appears to be a recapture of water and odor vapors.

35622

Coordinating Research Council Inc., New York, Air Pollution Research Advisory Committee

APRAC. INTERIM STATUS REPORT. 31p., July 1971.

Engineering, atmospheric, medical, and in-house projects an automotive air pollution, generated by the Air Pollution Research Advisory Committee of the Coordinating Research Council, are briefly summarized. The projects include studies on the effects of gasoline additives; use of leaded fuels; fuel volatility; gasoline composition; exhaust odors; combustion processes; automotive fueling emission; driving patterns; measurement methods for nitrogen oxides, oxygenates, particulates, and polynuclear aromatics; chamber reactivity; plant damage; diffusion models; carbon monoxide and light hydrocarbons in the atmosphere; haze formation; pollution in urban areas; effects of carbon monoxide, aromatic hydrocarbons, oxidants, and nitrogen oxides human health; exhaust gas sampling; and vehicle emissions. A list of published reports is included.

35635

Reckner, L. R., W. E. Scott, and W. F. Biller

THE COMPOSITION AND ODOR OF DIESEL EXHAUST. Proc. Am. Petrol. Inst., Sect. III, vol. 45:133-147, 1965. 11 refs. (Presented at the American Petroleum Institute Division of Refining, Midyear Meeting, 30th, Montreal, Quebec, May 10, 1965.)

Sampling and analysis techniques are described for determining light hydrocarbons, nitrogen oxides, formaldehyde, acrolein, total aldehydes, total particulate, and polycyclic aromatic hydrocarbons in diesel exhaust, using infrared spectrometry, chromatography, fluorescence spectrophotometry, colorimetry, and mass spectrometry. Using these techniques, results are reported on the composition of exhaust from two diesel engines, a two- and a four-cycle, under a variety of operating conditions. Smoke ratings using different techniques are also reported and compared to total particulate results. No correlation was found between smokemeter ratings and particulate loadings at other than black smoke conditions. Human panel observations of exhaust odor are being made as part of a continuing program, but no panel data are reported. (Author abstract modified)

35638

Hemeon, Wesley C. L.

GAS CLEANING EFFICIENCY REQUIREMENTS FOR DIFFERENT POLLUTANTS. J. Air Pollution Control Assoc., 12(3):105-108, March 1962. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 54th, New York, June 11-15, 1961.)

Knowledge is now available to identify the particular air pollution problems of a community and to derive engineering specifications for the performance of gas cleaning equipment, stack heights, or other control measures based on permissible ground concentrations. Dust weight emission rates, stack gas smoke and haze units, stack gas dustfall, incinerator paper ash, corrosion potential, and odors are discussed. Concentrations of a gaseous contaminant, usually expressed as ppm in the ambient ground level atmosphere, demand the same kind of units to express stack gas concentrations which, when multiplied by the stack gas flow rate, give the emission rate in cubic feet per hour. The common description of smoke and haze ground concentration in the units COHs per foot of air demands the same kind of units for a description of smoke concentration in stack gases and consistent units for total rate of emission of smoke. Measurement methods appropriate to the same kind of measurement at ground level as in stack gases are needed.

35673

Seltzer, William, Stanley G. Moum, and Tevis M. Goldhaft

A METHOD FOR THE TREATMENT OF ANIMAL WASTES TO CONTROL AMMONIA AND OTHER ODORS. Poultry Sci., 48(6):1912-1918, 1969. 10 refs.

Flake paraformaldehyde as it disintegrates has the unique ability to neutralize ammonia gas produced by animal wastes. Because falke paraformaldehyde liberates formaldehyde gas slowly, it has an antimicrobial action that destroys a variety of organisms capable of producing noxious gases, thus minimizing odors that accompany decaying animal wastes for a prolonged period. The retention of nitrogen in flake paraformaldehyde-treated manure under a variety of field conditions was repeatedly confirmed by tests. Animals produce manure at a rate of approximately one pound of wet manure for each pound of feed consumed; flake paraformaldehyde should be placed in anticipation of manure production on the area where the manure would be deposited. The level used should be half of 1% of the total anticipated manure production for a 3- to 4-week period. (Author summary modified)

35693

McCabe, Louis C.

ATMOSPHERIC POLLUTION. Ind. Eng. Chem., 45(6):107A-108A, June 1953. 1 ref.

Atmospheric conditions in the San Francisco Bay area were summarized. In San Francisco there are complaints of two types of odors: odors localized in the Islais Creek area and attributed to packing house, fish cannery, and fertilizer plant operations and odors in the Richmond, Sunset, Pacific Heights, and Nob Hill areas which are comparable to smog. Residents of Napa, Solano, and Contra Costa Counties, complain that, under unfavorable weather conditions, there are objectionable odors from the industrial plants located along the shores of San Pablo and Suisun Bays. The discharge of pollutants from operations located between Palo Alto and South San Francisco are, in general, blown over the bay and cause no complaints from residents of San Mateo County other than in the Redwood City area. A number of reports indicate there is frequent circling of the wind and a localized reduction of visibility with some odor nuisance in the location. There is reason to believe that a large portion of the nuisance to residents of San Mateo County is attributable to burning of trash and garbage dumps. Dumps are located where the volume and drift-direction of the smoke are readily discerned. Savings resulting from smoke elimination in Pittsburgh amount to 27 million dollars.

B. CONTROL METHODS

00025

P. A. Kenline and J. M. Hales

AIR POLLUTION AND THE KRAFT PULPING INDUSTRY (AN ANNOTATED BIBLIOGRAPHY). Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. (999-AP-4) Nov. 1963, 126 pp.

Since the first kraft mill came into existence in 1891, the potential odor problem has been well recognized. Accordingly, a great deal of literature has been published describing practical and theoretical work in the field of kraft mill odor control. Some progress has been made, but even today most kraft mills are faced with serious problems of atmospheric pollution. The following work provides an annotated bibliography of articles concerning measurement and control of kraft mill air-borne pollution currently available in the literature. It is the author's intention that this should provide a retrospective view of what has been accomplished and should form a sound basis for further work in the field. In addition to 154 abstracts, this bibliography contains a description of the iraft pulping process, a survey of mill emissions, and a consideration of control measures. (Author)

00032

M.F. Kasparick

ODOR CONTROL FOR A CHEMICAL PLANT. Air Eng., 7(1):22-25, Jan. 1965.

Daily checks, testing and efficient use of pollution control equipment were used to control odor at a Neoprene plant in Montague, Michigan. This was achieved by on and off plant odor patrols, prompt odor comment investigations and air sampling. The extent of odor created by a chemical can be calculated by knowing the threshold odor concentration of the chemical or chemicals involved. Redesign or replacement of inadequate odor abatement equipment reduces or eliminates sources of odor. As a test of overall plant effectiveness, off-plant monitoring of the air is done daily. If a rise in odors is noted, corrective measures can be applied before the odors become a problem.

00246

TROUBLE FREE WASTE INCINERATION. Southern Eng., 84(6):54-55, June 1966.

A three-burner natural gas incinerator having a capacity of 3,000 pounds per hour is described. The patented 3-chamber, semi- parabolic design of the incinerator affords maximum reflection and heat concentration for complete combustion. Centrifugal force traps soot and fly ash. Partially-combusted gases and non- combustible particles from the first chamber are drawn into a second chamber, where a continous supply of fresh air is introduced to complete combustion of the gases and burn off smoke and odors. Combusted gases and particles enter a third chamber, in which the after-burning process is continued and particles are removed before gases enter the stack. Five hundred pounds of refuse are reduced to a shovel full of ashes.

00257

A. G. Sandomirsky, D. M. Benforado, L. D. Grames, and C. E. Pauletta

FUME CONTROL IN RUBBER PROCESSING BY DIRECT-FLAME INCINERATION. J. Air Pollution Control Assoc., 16(12):673-676, Dec. 1966 (Presented at the 59th Annual Meeting, Air Pollution Control Association, San Francisco, Calif., Paper 66-55, June 24, 1966.)

The application of direct-flame incineration to successfully eliminate a smoke-oil-mist and odor problem in the manufacture of rubber-base rug underlay is presented. The investigation of various air pollution control processes leading to the development and adoption of the direct flame incineration system is covered. The rug underlay curing process incorporating the direct-flame incineration system with primary heat recovery is described. Results and discussion of a source test to determine the effectiveness of direct-flame incineration in this application are included. (Authors' abstract)

00286

D. L. Brooman and E. Edgerley, Jr.

CONCENTRATION AND RECOVERY OF ATMOSPHERIC ODOR POLLUTANTS USING ACTIVATED CARBON. J. Air Pollution Control Assoc., 16(1):25-29, Jan. 1966.

Activated carbon filters were used to concentrate atmospheric mixtures of acrolein, methyl sulfide, and n-propyl mercaptan. Removal efficiency and carbon capacity for each of the odor compounds were investigated using two different carbons, Cliffchar (4-10 mesh) and Barnebey-Cheney (C-4). A closed system was devised to establish a known atmospheric odor concentration for each filter run. Solvent extraction techniques were employed to desorb and recover the odor compounds from the carbon filters. All quantitative analyses were conducted with gas liquid chromatography utilizing the hydrogen flame ionization detector. The removal studies conducted indicate that the efficiency of removal of a carbon filter is essentially 100% up to the point of filter breakthrough. This breakthrough point is governed by the filter's capacity for a particular compound. This study indicated that the filter capacity is dependent both on the type of carbon employed and the particular odor compound adsorbed. Solvent recovery of the odor compounds from the carbons varied from 0 to 4.5% for the mercaptan up to 96 to 98% for acrolein. Percent recovery was found to vary for a given odor compound with different carbons and for a given carbon with different odor pollutants. (Authors' abstract)

00358

W. Viessman

CONTROL OF ODORS IN WORKING ENVIRONMENTS. Occupational Health Rev. 17, (2) 12-22, 1965.

A need for odor control in our industrial complexes and large congested cities is indicated. The quality, intensity, acceptability and pervasiveness of common household and industrial odors are discussed, as a means of identification and evaluation. Tolerances and sources of odors are given. Various means of odor control are presented. These include: diltuion by ventilation air; physical and chemical absorption using washers, scrubbers and condensers; adsorption with activated charcoal filters and by-product recovery; semi-sorption; modification, counteraction and masking; and catalytic oxidation and combustion methods. (Author)

00379

G. A. Jansen and D. F. Adams

ABSORPTION AND CHLORINE OXIDATION OF SULFUR COMPOUNDS ASSOCIATED WITH KRAFT MILL EFFLUENT GASES. Preprint. 1966.

Absorption of methyl mercaptan and H2S into aqueous solutions of Cl, NaOH, and Cl plus NaOH has been studied using a 2 in diameter absorption column packed with 1/4 in. Intalox saddles. Absorption rates were noticeably affected by chemical reactions occurring in aqueous Cl and OH media. Potentiometric methods were used to follow the reactions of mercaptan and sulfide in aqueous chlorine solutions. Mercaptan apparently was converted by aqueous Cl absorption media to dimethyl disulfide and stripped off in the effluent gas. The percentage conversion increased with increasing pH. The absorption of H2S in aqueous Cl (pH 2 to 13) was highly pH dependent. The absorption rate increased slowly as the pH of the feed solution increased to pH 11. Sulfate was the resulting oxidation product. At pH 11, the rate of absorption dropped slightly, then rose sharply at pH 12. Elemental S became the major product at pH 12 and above and fouling of the packed column occurred. The effect of pH on formation of sulfate and/or elemental S in chlorine-sulfide reactions was explained by Choppin and Faulkenberry (1937). The absorption of sulfide in aqueous NaOH increased until the feed hydroxide to sulfide ratio was 1. At higher ratios, the absorption rate remained constant. Apparently, sodium bisulfide was the absorption product. The results of these studies indicate that aqueous Cl solutions at pH above 12 can be effectively used for removal of H2S in absorption equipment designed to handle S in suspension. The absorption of methyl mercaptan in aqueous Cl solution appeared to be impractical since dimethyl disulfide was apparently the only product formed and was stripped from the tower by the gas stream. Hydroxide solution was effective for absorption of both methyl mercaptan and H2S when hydroxide to sulfide or mercaptan feed ratios were greater than 1 or 1.8 respectively. (Author)

00504

D.A. Jensen

SEPARATING FACT FROM FICTION IN AUTO SMOG CONTROL. Arch. Environ. Health, 14(1):150-155, Jan. 1967. (Presented at the American Medical Association Air Pollution Medical Research Conference, Los Angeles, Calif., March 2-4, 1966.)

Author gives a status state-of the -art summary of the various sources of emissions from automobiles. Topics covered are: crankcase emission controls; servicing and maintenance; requirement of a 'closed' system or one equally effective, exhaust emission controls; evaporative emissions; oxides of nitrogen emission controls; diesel smoke and odor emission controls; cars and fuels of the future. In addition, author discusses the impending vehicle emission control which will be put into effect for 1968 motor vehicles.

00541

FUMES INCINERATION EFFECTIVE FOR ODOR POLLUTION CONTROL. Ind. Heating 33(7):1266-1272, July 1966.

Fume incineration, employed in a new installation for sewage treatment to eliminate odors, is described. During sewage processing, odorous gases are present at several points: the sedimentation tanks, the outfall system and the inlet sewage supply line. The odorous gases are collected at these critical points, piped to the incinerator and destroyed by burning at temperatures of 1100-1500 F. At these temperatures, the odor-causing materials are no longer organically stable and become decomposed, so that the incinerator exhaust is odor-free.

00552

F.H. Cady

A KRAFT MILL WASTE CHLORINE GAS RECOVERY SCRUBBER. Preprint. (Presented at the Second Annual Meeting, Pacific Northwest International Section, Air Pollution Control Association, Portland, Oreg., Nov. 5-6, 1964.)

Although most of the normal air contaminants around Weyerhaeuser's Kraft Pulp Mill at Everett, Washington had been removed, obnoxious waste chlorine gases occasionally produced poor working conditions. A caustic gas-recovery scrubber with appropriate ductwork was installed. This scrubber, while removing the waste gases from the atmosphere, pays for itself by the resulting formation of hypochlorite bleach liquor. (Author's abstract)

00571

T. B. Henshaw

ODOR CONTROL AT 2, 4-D PRODUCTION PLANT. J. Air Pollution Control Assoc. 15(11):516-518, Nov. 1965. (Presented at the Second Annual Meeting of the Pacific Northwest International Section, Air Pollution Control Association, Portland, Oreg., Nov. 5-6, 1964.)

Report describes an odor control system for 2, 4-D weed killer production which is based on an efficient countercurrent scrubbing of the odorous acidic gases with a sodium hydroxide solution. System described seems to be effective. 00571 T. B. Henshaw

00975

M. I. Weisburd, (Compiler and Ed.)

AIR POLLUTION CONTROL FIELD OPERATIONS MANUAL (A GUIDE FOR INSPECTION AND ENFORCEMENT). Public Health Service, Washing- ton, D. C., Div. of Air Pollution, 1962. 291p.

Author discusses sources, control methods, training techniques and related aspects of air pollution. Document is an excellent source for specific information on equipment being used in air pollution control. Pictures, diagrams, schematics and charts are given.

01352

C. Duerden

A PROBLEM OF FUME EMISSION. Public Health Inspector 74, 21-9, Oct. 1965.

A case study of the efforts to control the fumes and odor from hardboard heat treatment chamber in Great Britain is presented.

01414

J. L. Sullivan, F. L. Kafka, and L. M. Ferrari

AN EVALUATION OF CATALYTIC AND DIRECT FIRED AFTERBURNERS FOR COFFEE AND CHICORY ROASTING ODORS . J. Air Pollution Control Assoc., 15(12):583-586, Dec. 1965.

Though the aroma of roasting coffee can be pleasant in small amounts, large scale plants tend to cause public complaints. As a means of control thermal afterburners operating at 1200 F and higher have been commonly employed. Australian coffee consumption in the past has been relatively small but in recent years it has been increasing markedly. As a result, odor complaints have been increasing and one plant, large by Australian standards, caused a public outcry of no small order. High cost of fuel rendered thermal afterburning unattractive and, consequently, the firm in question decided upon catalytic combustion as an alternative. Subsequently, the unit was installed and before and after tests were made for various components. At an operating temperature of about 700 F the results showed comparable fume reductions to thermal afterburning and the findings were confirmed by the cessation of complaints by the public. (Author abstract)

01505

C. I. Harding and J. E. Landry

FUTURE TRENDS IN AIR POLLUTION CONTROL IN THE KRAFT PULPING INDUSTRY. TAPPI 49(8):61A-7A, Aug. 1966. (Presented at the Annual Meeting, National Council for Stream Improvement, New York City, Feb. 21-24, 1966.)

Measured gaseous and particulate emission figures are presented with recent advances in emission control technology as bases for proposing the types and extent of emission control to be utilized by the pulp industry during the next 5 yrs. A major detrimental effect is the corrosive nature of the particulate and gaseous emissions from kraft pulping. Sources of sulfur compounds are 2 large kraft mills and 2 large oil-fired electric generating stations. Sampling can be done by simple tests to give total monthly exposure. Three determinations are dustfall, lead peroxide candles for sulfation rates, and corrosion rate measurements. Subjective tests for odors and odor intensity can be accomplished through odor panels or odor recorders at various distances from the mill. A simple wet technique for measuring the concentrations of SO2, hydrogen sulfide, mercaptans, organic sulfides, and organic disulfides in mill vents was developed and has been utilized in Southern mills.

01508

J. O. Ledbetter

AIR POLLUTION FROM WASTE WATER TREATMENT. Water Sewage Works 113(2):43-45, Feb. 1966.

There is air pollution from the treatment of wastewaters. This pollution involves not only the notorious odors and the recognized volatiles but also the aerosol emissions. The aerosols of most interest are probably the bacteria. Significant numbers of bacteria, including some pathogens, are emitted from activated sludge and trickling filter units. The methods of engineering control currently available can readily solve the problem. Even better solutions will likely be forthcoming if the problem ever warrants considerable research.

01537

ELIMINATING SMELL FROM A REFINERY. Petroleum (London) 29(4):148-150, Aug. 1966.

The methods used for eliminating smell from a refinery are described. Even after use of an elaborate water purification system, schematically presented in this article, odor remained. The odor was traced to the waste water collection pit. It was found that a triple layer of Allplas polypropylene 45 mm diameter balls spread over the surface of the water in the collecting pit eliminated the odors. A single layer of balls reduced the amount of fuel needed to maintain a given solution temperature by 70%, and reduced evaporation by 88%.

01549

S. Lindberg

HOW UDDEHOLM DESTROYS AIR AND WATER POLLUTANTS AT THE SKOGHALL WORKS. Svensk Papperstid. (Stockholm), 69(15):484-487, Aug. 15, 1966.

Measures taken at the Skoghall sulfate mill in order to eliminate malodorous air and water polutants are described. The malodorous gases are destroyed by combustion. Gaseous mixtures not containing oxygen are burned in a recovery boilder. The gases, however, which are mixed with air on cleection, are eliminated in a specially designed furnace installed as a preliminary oven to a conventional boiler. The worst water pollutants are cooking and evaporation condensates. Before being released into the recipient, the cooking condensate is freed from malodorous components by blowing with steam through a column. The evaporation condensate, whose impurity mainly consists of hydrogen sulfide, is scrubbed in a satisfactory manner by mixture with blackwater from the chlorination stage of the bleaching plant. The total sulfide content in the waste water has been reduced from 6 lbs. to 1 lb. H2S per ton pulp. These measures have given the desired results, and the plant now functions in a safe manner. The capital outlay has been moderate and the process costs are very low. (Author summary)

01563

R. C. Gumerman and D. A. Carlson

METHYL MERCAPTAN REMOVAL BY SOIL FILTRATION. Preprint. (Presented at the Annual Meeting of the Pacific Northwest International Section, Air Pollution Control Association, VANCOUVER, BRITISH COLUMBIA, NOV. 2-4, 1965.)

The use of soil bacteria as a method for removing odor from gaseous mixtures appears highly feasible. In this study, efficiencies approaching 100% removal were obtained after a six-week acclimation period, using only three and one-half feet of soil. Apparently this is not the limit toward applicability of this method, since at the end of the six-week study period, the bacterial population was still increasing, indicating further potential still to be displayed. Although this idea could be applicable in itself in large installations such as kraft pulp mills, it may be more economically promising if it could be used in conjunction with a spray irrigation network used for the removal of excess BOD in the waste liquor. In essence, this would provide double benefit from the land. This idea assumes that the spent liquor is not toxic to the odor reducing microbes, and conversely that the odor is not toxic to the waste utilizing microbes. As an additional benefit, the alkaline waste liquor would keep the soil pH from consistently dropping as was shown to occur in this research. Although this idea is only a hypothesis, it is felt that due consideration should be given to it, as it performs the dual role of odor and BOD removal, which would be of economic advantage to any kraft mill utilizing it. (Author conclusions)

01613

A.H. Rose, Jr

DIESEL SMOKE PROBLEM. Preprint. (Presented at the 1963 Metropolitan Conference on Air Pollution Control, Cincinnati, Ohio, Oct. 22, 1963.)

The problems of diesel smoke, odors, and irritation have long been recognized. Considerable effort has been made over the past several years toward the measurement and control of the objectionable qualities of diesel exhaust. No new information or control devices are needed to control the smoke emissions from diesel engines. If properly designed, operated, and maintained, if supplied with proper fuels, and if not overloaded or lugged, diesel engines can be operated without emitting smoke in objectionable amounts. The odorous and irritating compounds of diesel exhaust have not yet been adequately defined. In contrast to reduction of excessive smoke, the odors and irritating effects will not be eliminated merely by improving engine operation, maintenance, and fuel. No adequate methods of odor control for the diesel engine are currently available. Some reduction in odor intensity can be achieved by proper engine operation and maintenance and by the use of proper fuels.

01672

U. S. Public Health Service, Washington, D. C., Div. of Air Pollution

REPORT ON INTERSTATE AIR POLLUTION IN THE SHOREHAM, VERMONT - TICONDEROGA, NEW YORK, AREA. Preprint, ((43))p., 1965. 14 refs.

A summary is presented of the activities undertaken by the Abatement Branch, Division of Air Pollution, Public Health Service, DHEW, subsequent to a request by the Vermont government alleging that air pollution emanating from an International Paper Company pulp plant in Ticonderoga, New York, endangers the health and welfare of persons in nearby Vermont. The activities of the Abatement Branch were threefold: (1) inspection of the pulp mill operated by the International Paper Company in Ticonderoga, New York, (2) review of available topographical and meteorological information, and (3) calculations of emissions, transport and diffusion of odorous materials from the mill site.

01867

K.J. Springer, P. Lepisto, C. Wood

INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE. Southwest Research Inst. San Antonio, Tex., Div. of Engines, Fuels, and Lubricants. (SwRI Proposal 10-4336A) Nov. 19, 1965. 46 pp.

This is a proposal from the Southwest Institute to assist the U.S. Public Health Service in setting reasonable, practical, and realistic smoke and odor standards for diesel powered vehicles. This assistance will involve obtaining additional basic data in the form of dilution ratios and operating conditions most conducive to the production of odor and smoke. A usable panel technique for measurement of odor will be developed as will chassis dymamometer procedures for evaluation and test of smoke and/or odor control devices. Various control devices will be evaluated using these chassis dynamometer methods and finally, fleet evaluation of the most promising control device(s) will be conducted.

01900

E. R. Hendrickson and C. I. Harding.

BLACK LIQUOR OXIDATION AS A METHOD FOR REDUCING AIR POLLUTION FROM SULFATE PULPING. J. Air Pollution Control Assoc. 14, (12) 487-90, Dec. 1964. (Presented at the 57th Annual Meeting, Air Pollution Control Association, Houston, Tex., June 20-21, 1964.)

This paper will discuss the sources of odorous air pollutants from sulfate pulping operations. One of the major sources is the recovery furnace. Odors from this source can be reduced considerably by oxidation of the black liquor prior to evaporation and burning. The procedure has been used with considerable success in the northwestern and northeastern parts of the United States. Unfortunately, the majority of sulfate pulp production occurs in areas where southern pine is the basic raw material. For several reasons the black liquor resulting from southern pine operations presents problems when the usual oxidation procedures are used. Although not as effective as normal balck liquor oxidation strong black liquor can be oxidized without too much difficulty. Various procedures of oxidation of black liquor will be discussed. Results of stack sampling in U.S. pulp mills with and without the oxidation unit in operation will be reported. (Author abstract)

02018

E.R. Hendrickson C.I. Harding

AIR POLLUTION PROBLEMS ASSOCIATED WITH 'KRAFT' PULPING. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper IV/6). pp. 95-7.

The Air Pollution Research Laboratory of the University of Florida has been investigating air pollution problems of the kraft pulping industry since the early 1950's. The problems of this industry involve emission of a variety of particulates plus odorous and non-odorous gases. The problems are compounded by the complicated nature of the organic reactions involved. The industry, however, has made great strides in reducing its air pollution potential. This paper describes the process by which kraft pulp is produced, the sources of pollutants, and the methods presently known for alleviating the air pollution problems. New approaches also are discussed which might prove beneficial in improving air quality in the vicinity of pulp and paper mills. (Author abstract)

02047

M. W. First

CONTROL OF HAZE AND ODOURS FROM CURING OF PLASTICS. Proc. (Part I) Intern. Clean Air Cong., London, 1966. (Paper VI/11). pp. 188-91.

The curing of plastisols and highly plasticized vinyl products by heat in continuous processing ovens requires ventilation to prevent formation of explosive atmospheres by the volatile components and to eliminate product spoilage by condensation and dripping of the higher-boiling fractions. Exhaust ventilation rates of one or more air changes per minute are used frequently and the effluent air is heavily contaminated with condensed, submicronsize oil droplets derived from the volatilization of plasticizers, such as dioctyl phthalate (DOP) and a number of amines and organic sulphur-containing substances that form from the curing of rubber and plastic-based strips, films, and coatings. The resulting haze and malodours represent a severe air pollution nuisance in the vicinity of these processing factories. Experiences with emission control by direct and catalytic combustion and by a number of water scrubbing devices are described and test data are presented. (Author abstract)

02279

J.E. Landry D.H. Longwell

ADVANCES IN AIR POLLUTION CONTROL IN THE PULP AND PAPER INDUSTRY. Tappi 48, (6) 66A-70A, June 1965. (Presented at the Annual Meeting, National Council for Stream Improvement, New York City, Feb. 23, 1965.)

Black liquor oxidation, electrostatic precipitation, secondary scrubbing, lime kiln scrubbers, digester relief and vent gas disposal are covered.

02427

R. L. Stenburg

CONTROL OF ATMOSPHERIC EMISSIONS FROM PAINT AND VARNISH MANUFACTURING OPERATIONS. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution (Technical Rept. No. A58-4) 33 pp., June 1958. Also published in Paint Varnish Prod. 49, 61-5, Sept. 1959 and Paint Varnish Prod. 49, 111-4, Oct. 1959.

Air pollution problems associated with the manufacture of protective coatings result primarily from the high temperature processing of natural and synthetic oils and resins to produce paint and varnish vehicles. The release of malodorous materials is the most widespread problem and the most difficult to control. Since fume components are predominantly of hydrocarbon compositions, they have the potential to contribute to the formation of smog in those areas where air pollution is well established. Property damage is also a definite possibility from some of the processes employed. The majority of fumes from cooking processes may be controlled by liquid scrubbing or by incineration, the latter being more effective in reducing the small but offensive portion of the total fume output that is largely responsible for the odor problem. Activated carbon adsorption is effective on certain highly odorous materials in processes other than cooking. These and other types of controls are in general usage throughout the industry and are serving to greatly reduce the amount of undesirable materials discharged to the atmosphere. (Author summary)

02488

C. N. Stutz.

TREATING PARATHION WASTES. Chem. Eng. Progr. 62, (10) 82-4, Oct. 1966.

Pilot plant tests were made of parathion wastes combined with domestic wastes to assure the city that the wastes can be treated successfully in the municipal activated sludge treatment plant. Expansion of the parathion plant requires the development of design criteria for a pretreatment plant. Incineration of residues and scrubbing and demisting of the off-gases are practical. Limestone neutralization of the acid streams followed by blending with alkaline streams before biological treatment is used to control the pH.

02725

A. P. Banner and E. M. Ilgenfritz

DISPOSAL OF COAL TAR PITCH DISTILLATE OBTAINED FROM CARBON BAKING FURNACE BY CATALYTIC COMBUSTION. Preprint. J. Air Pollution Control Assoc. 13, (12) 610-2, Dec. 1963. (Presented at the 56th Annual Meeting, Air Pollution Control Association, Detroit, Mich., June 9-13, 1963, Paper No. 63-34.)

The air pollution problems associated with coal tar pitch fumes evolved in the manufacture of baked carbon cannot be tolerated due to odor of fumes which contain pyrene, phenanthrene, fluorene, chrysene and related aromatic compounds. Elimination of coal tar fumes was obtained by catalytic destruction at a temperature of 550 C. Complete destruction of aromatic compounds is realized with some unburnt free carbon discharged to the atmosphere. Choice of installation was based upon economics and ability to eliminate fumes. Preliminary data were obtained from work on a pilot unit. (Author abstract)

02729

J. F. Byrd, H. A. Mills, C. H. Schellhase, and H. E. Stokes

SOLVING A MAJOR ODOR PROBLEM IN A CHEMICAL PROCESS. J. Air Pollution Control Assoc. 14, (12) 509-16, Dec. 1964. (Presented at the 56th Annual Meeting, Air Pollution Control Association, Detroit, Mich., June 9-13, 1963.)

Paper describes the control of a highly objectionable odor (dimethyl amine) from one of the raw materials which are handled at Proctor and Gamble Company, Kansas City Plant, for ultimate use in the manufacture of synthetic detergents. Included is a discussion of methods of actually placing a quantitative concept on odor to determine the maximum discharge of odorous material to the atmosphere without creating an odor problem. Engineering design approaches to odor abatement are discussed.

02794

INTERSTATE AIR POLLUTION IN THE SELBYVILLE, DELAWARE - BISHOP, MARYLAND AREA. Preprint. Public Health Service, Washington, D.C., Div. of Air Pollution. Nov. 1965.

Pursuant to a request from the State of Delaware official air pollution control agency, the Secretary of Health, Education, and Welfare, under provisions of Section 5 of the Clean Air Act, Public Law 88-206 (42 U.S.C. 1857-1857g), called a conference to be held November 9, 1965, in Selbyville, Delaware, regarding an interstate air pollution problem in which it is alleged that 'an obnoxious and nauseating odor' and 'a horrible stench' originating at a plant operated by Bishop Processing Company in Bishop, Maryland, endanger the health or welfare of persons in the Selbyville, Delaware area. Operations of the plant consist of the rendering of chicken offal and feathers, beef bones and fish for the production of high-protein additives used in dog, cat and poultry feed; bone meal for fertilizer; tallow; and mixed vegetable-animal fats. This report summarizes the activities undertaken, subsequent to receipt of the Delaware request, by the Abatement Branch, Division of Air Pollution, along the following lines: (1) investigation of odors in the Selbyville-Bishop area, (2) review of available topographical and meteorological information, and (3) inspection of the plant operated by Bishop Processing Company.

03129

Avy., A. P.

METHODS OF REDUCING POLLUTION CAUSED BY SPECIFIC INDUSTRIES. (CHAPTER VI. CHEMICAL INDUSTRY). European Conf. of Air Pollution, Strasburg, 1964. p. 337-356.

The pollutants discharged by the chemical industry may be subdivided into several classes. The first and most important class is that of harmful products emitted in large quantities by the 'heavy' chemical industry and, in particular, organic chemical works: Sulphur dioxide, sulphuric acid, chlorine, whether manufactured or in the form of impurities in the basic material: fluorine in the case of fertilizers and fluorine again in aluminum electro-chemistry. The chemical industry has a wide range of special problems which is in a constant state of flux owing to the wide and ever-increasing variety of new synthetic products (intermediate and finished) in the organic chemical industry. From the technical point of view, the prevention of pollution by such products depends on their presentation and manner of application. A problem directly connected with chemical manufacture is that of smell: mercaptans, hydrogen phosphide, methylamines, etc., although, of course, it does not arise in the chemical industry alone. Technical methods used to reduce pollution are highly devellped for dusts and smoke and there is a wide choice of apparatus. The chemical industry, like all others, is subject to laws and regulations governing industrial air pollution. A fairly sharp distinction, however, should be drawn between laws, which lay down in general terms the objects to be attained and the obligations to be fulfilled, and the regulations which embody detailes of the limits imposed and the degree of reduction demanded. In this last report, caution is necessary and impossible or unnecessary standards should not be set. It is clear that international liaison or even international collaboration is not only desirable, but necessary.

03297

W. L. Faith.

ODOR CONTROL IN CATTLE FEED YARDS. J. Air POLLUTION Control Assoc. 14, (11) 459-60, Nov. 1964 (Presented at the 57th Annual Meeting, Air Pollution Control Association, Houston, Tex., June 20-25, 1964.)

Commercial cattle-feeding is a large industry in the United States. In California, for instance, there are more than 500 commercial feedlots. Each of these lots handles from less than 500 to more than 50,000 head of cattle at one time. With the urban and suburban explosion, feedlots that were at one time many miles from residential centers are now 'just across the street.' Naturally the high odor level from improperly operated yards gives rise to considerable complaint and citizen indignation. A variety of methods to reduce odor to an acceptable level have been tried with varying results. A highly satisfactory procedure is based on 'good housekeeping' practices, frequent removal of fecal material, and abatement of residual odor by spraying the lots at designated intervals with a solution of potassium permanganate. Details of the method are discussed.

03499

A. Turk

ODOR CONTROL METHODS: A CRITICAL REVIEW. Am. Soc. Testing Mater., Spec. Tech. Publ. 164 69-80, 1954

Methods now commercially available for control of odors by treatment of the odorous air may be divided into four general classifications: combustion, adsorption, absorption, and vapor mixing. This review highlights the facts that there is no one universal 'odor control method,' that the technology of the subject often presents complexities, and that there are areas wherein no commercially available equipment or materials are as yet economically satisfactory. These considerations account for the fact that practical odor problems require individual study that may be based on familiarity with the process or materials that constitute the source, chemical analysis of the composition and concentration of the offending gases or vapors, and organoleptic appraisal of their effects on humans. Whenever feasible, it is advisable that pilot installations be made before large-scale applications of any control method. Combinations of treatments, possibly with dispersal methods, may be indicated.

03807L

THE CHLORINE OXIDATION OF SULFUR COMPOUNDS IN DILUTE AQUEOUS SOLUTION. National Council for Stream Improvement, Inc., New York City. (Atmospheric Pollution Technical Bulleting 18.) June 1963. 16 pp.

Oxidation of sulfide in aqueous solution requires between 2 and 3.4 moles of Cl2 per mole of sulfide, depending upon conditions and the fraction of the sulfide oxidized. Oxidation of all the sulfide present requires at least 2.35 moles of Cl2 per mole of sulfide. Sulfate is a major product. Complete oxidation of methyl mercaptan in neutral or acid solutions requires between 2.4 and 3.3 moles of Cl2 per mole of mercaptan. Under basic conditions, methyl mercaptan apparently reacts to form an intermediate which, in turn, appears to oxidized by Cl2 once all the mercaptan has reacted. Formation of the suspected intermediate requires some 1.5 moles of Cl2 per mole of mercaptan, but a total of about 2.6 moles of Cl2 per mole of mercaptan must be added before the first trace of excess Cl2 can be detected. All attempts to identify the products of these reactions failed–probably because the concentrations involved were below the sensitivity limits of the tests used. Oxidation of dimethyl sulfide required 1.8 moles Cl2 per mole of sulfur. Oxidation of dimethyl disulfide required 5.2 moles of Cl2 per mole of disulfide–equivalent to 2.6 moles of Cl2 per mole of sulfur. All of the Cl2 oxidations were rapid enough to be complete before iodine was added. This means that the oxidations of inorganic sulfides and mercaptans required less than one minute and oxidation of the organic sulfides took less than five minutes.

03946

W. Lenz A. Tirado

MEXICAN KRAFT MILL USES OBSERVERS TO CHECK ITS ODOR CONTROL PROGRAM. Paper Trade J. 150, (34) 64, 68, Aug. 1966.

A method is described whereby a Mexican kraft pulp mill is able to evaluate the effectiveness of its odor control program. Persons residing within a given distance of the mill are asked to provide information regarding odors at their homes on a standard form. This information is coordinated with meteorological data and plant activities. Under the assumption that either the blow or the gas relief are the main cause of trouble, a 'relative index' is compiled by dividing the total weekly complaints by the total number of blows for the week. This is used as a measure of odor level and is recorded graphically to illustrate the improvement or decline of conditions.

03966

M. J. Boldue, R. K. Severes, and G. L. Brewer

TEST PROCEDURES FOR EVALUATION OF INDUSTRIAL FUME CONVERTERS (SAMPLING AND ANALYTICAL TECHNIQUES REVIEWED FOR). Air Eng. 8, (2) 20-3, Feb. 1966. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965.)

The purpose for development of the source testing outline was to permit systematic evaluation of air pollution control equipment on gaseous organic fume streams. Data were obtained to fulfill the following objectives of the source outline: (1) Determination of combustible emission and conversion efficiency. (2) Determination of particulate matter emissions. (3) Identification of specific emissions by laboratory analyses. (4) Determination of the odor concentration of the effluent stream in conjunction with these objectives of source test measurements, the outlined program was to include: (5) A method to check credibility of sampling and analyses. (6) A technique for future monitoring of the control equipment performance. Source tests were conducted on catalytic fume converter units located on a metal-coating oven, a varnish-cooking kettle, a phthalic anhydride plant and a wire-coating oven. Sampling procedures, analytical techniques and developed equipment are discussed. The results of each of the evaluations of the catalytic fume converters are presented.

03972

A. J. Emanuel

POTASSIUM PERMANGANATE OFFERS NEW SOLUTIONS TO AIR POLLUTION CONTROL. Air Eng. 7, (9) 19-21, Sept. 1965.

The use of potassium permanganate to counteract a variety of odoriferous materials is described. Examples of its effectiveness in combating odors from rendering plants, asphalt plants, feed lots, manure piles, fish processing and sewage plants are given. Many air pollutants are attacked by the parmanganate solution, but due to the difficulty of predicting the degree of oxidation which occurs, it is usually necessary to make an actual trial before the economics of potassium permanganate application can be determined.

03976

S. I. Masuda, T. Onishi, H. Saito

INLET-GAS HUMIDIFICATION SYSTEM FOR AN ELECTROSTATIC PRECIPITATOR. Ind. Eng. Chem. Process Design Develop. 5 (2) 135-45, Apr. 1966.

A system for rapid evaporation of mist was developed for inlet-gas humidification in an electrostatic precipitator, which can evaporate a large quantity of water in a small spray chamber in the temperature range of 150 to 200 C. An improved type of multiple twin-fluid nozzles, developed for this purpose, can produce extremely uniform and small particles of mist in any amount, with the aid of an equal magnitude of high fluid resistances inserted into its water branches. Confinement of mist within the narrow space of a spray chamber was made possible by the mist thermal repulsion action of the wall surface kept at elevated temperature. The mist lifetime measured in an actual spray chamber can be explained by the theory, if a new type of mist average diameter is utilized. (Author abstract)

04045

A. A. Tirado, M. V. Guevara, and J. S. Banduni

OXIDATION OF BLACK LIQUOR BY AIR UNDER PRESSURE. J. Air Pollution Control Assoc. 12, (1) 34-8, Jan. 1962. (Presented at the 54th Annual Meeting, Air Pollution Control Association, New York City, June 11-15, 1961.)

It was decided to investigate the oxidation of black liquor by means of air under pressure. A samll reactor was used which consisted of a six-inch pipe about 28 inches long, provided with a diffuser at the bottom. Compressed air was admitted through that diffuser. Liquor and air, at variable quantities, were fed through the bottom, and the products of the reaction escaped through a pressure relief valve on the top of the reactor. The pressure relief valve was adjusted, so that a predetermined pressure was maintained in the reactor, while the temperature of the liquor was varied in order to see the effect of temperature. Liquors at the inlet and outlet of the reactor were titrated only by the Borlew and Pascoe method analysis (potentiometric), as it was known that such method practically determines both mercaptans and sulfieds. The oxidation of black liquor by air at 25 to 75 psig shows definite gains specially regarding the conversion of mercaptans, which are difficult to oxidize in conventional processes as used so far. Liquors at 50 psig and 65 C were well oxidized, provided that air was supplied at a rate of about 2.3 times the theoretical air requirement. This quantity of air is about one-third of the air usually added in conventional procedures at atmospheric pressure. Due to the increased pressure, the total power requirement including pumps, compressed air, etc., in the process being studied, was estimated to be approximately twice of the power consumption in a conventional Trobeck system. However, it is thought that the higher efficiencies obtained in the system under pressure should justify such increased power consumption. The oxidation of black liquors in kraft pulp mills is desirable because of three principal reasons: (a) elimination of malodors, (b) prevention of corrosion, and (c) reduction of sulfur losses. Nevertheless, the oxidized solids are to be burned in a boiler and their heat value should be preserved as much as possible. Thus, the oxidation of organic compounds, including mercaptans, should be limited, so that only those desirable effects are attained. It is believed that the reaction with air at a pressure of 50 psig or so is still mild enough as to perform this limited oxidation.

04227

E. R. Harris and F. R. Beiser

CLEANING SINTER PLANT GAS WITH VENTURI SCRUBBER. J. Air Pollution Control Assoc. 15, (2) 46-9, Feb. 1965

The installation and operating experience on what is believed to be the first application of a Venturi scrubber for cleaning sinter plant gases is reported. After running pilot plant tests at the stack, the Venturi scrubber was chosen in preference to the dry precipitators because it was believed that this would more effectively eliminate certain odors particular to this plant. A ruggedly built stainless steel fan with a rotor having forwardly curved, backwardly inclined blades was selected with extra heavy steel plate housing for quiet operation. Stainless steel moving parts and a rubber coated carbon steel housing were used to resist corrosion. The installation was completed and put on the line for the first time April 9, 1963. The discharge from the stack was only a small white plume and the stack dust loading was far below the County requirements and appreciably better than the manufacturer's guarantee. Vibration readings and noise level of the fan were excellent and the only indication of any problem was in carry-over through the fan of an estimated 50 to 60 gallons per minute of dirty water. This was somewhat higher than hoped for but not considered critical. On April 17, 8 days after start-up, a slight increase in vibration of the fan was noticed. Cursory inspection of the damage indicated that the failure was due to abrasion from the dust laden water carried over from the scrubber. Following the failure of the fan, several studies were undertaken in an effort to prevent rapid deterioration of the rotor. After a rebuilt rotor was put into service, an automatic vibration cutoff was installed which would shut the fan down in case of excessive vibration.

04300

E. Betz

ODOUR CONTROL BY CATALYTIC COMBUSTION. Proc. Clean Air Conf., 32nd, Eastbourne, Engl., 1965. pp. 69-78.

This paper outlines generally the problems which have been dealt with satisfactorily by catalytic combustion, the economics of catalytic combustion and alternative methods for the removal of odorous effluents. (Author abstract)

04361T

B. G. Gills, E. L. Howe

OIL BURNERS FOR DOMESTIC USE: PRESENT STATE, RECENT IMPROVEMENTS AND FUTURE DEVELOPMENTS. ((Olbrenner fur den Hausbrand: Gegenwartiger Stand, erzielte Verbesserungen und Moglichkeiten der Weiterentwicklung.)) Schweiz. Arch. (Zurich), 31(4):119-126, April 1965. 7 refs.

An oil furnace well built and maintained should cause no intolerable air pollution. Soot and a smell of oil will occur only in case of improper adjustment or perhaps in starting up. In the latter case an inadequate means of ignition, too low carburetor temperature, or excessive cooling of the flame may be the cause. Some methods of combating this difficulty are described here (beginning injection of fuel only after an adequate oil pressure is achieved, in the pressure atomizer burner; as nearly continuous operation as possible for evaporator furnaces; use of higher pressure for the air of combustion). In pressure atomizer burners such difficulties can usually be traced to defective nozzles or to poor combustion from other causes. Installations which give reise to complaints must therefore be overhauled and if necessary replaced. Determination of concerns itself among other things with the following problems: improved mixing of air and oil mists; influence of systems for recirculating smoke gases; ultrasonic and air-foam atomizer burners; electrostatic oil atomizing; total evaporation of the fuel in the vaporizer burner; and speed of combustion.

04533

A. Wallach

SOME DATA AND OBSERVATIONS ON COMBUSTION OF GASEOUS EFFLUENTS FROM BAKED LITHOGRAPH COATINGS. J. Air Pollution Control Assoc. 12, (3) 109-10, Mar. 1962. (Presented at the 54th Annual Meeting, Air Pollution Control Association, New York City, June 11-15, 1961.)

The waste gaseous effluents from baked coating operations are a concern in air pollution because of their odor as well as the irritant effects of the aldehydes present. A series of tests were made dealing with the effectiveness of high temperature incineration as well as catalytic combustion in controlling the effluent from the baking of lithographed cans. The data and information obtained are presented.

04627

H. S. Posselt and A. H. Reidies

ODOR ABATEMENT WITH POTASSIUM PERMANGANATE SOLUTIONS. Ind. Eng. Chem. Prod. Res. Develop. 4, (1) 48-50, Mar. 1965. (Presented at the Division of Water, Air, and Waste Chemistry, 148th Meeting, American Chemical Society, Chicago, Ill., Sept. 1964.)

With the objective of evaluating potassium permanganate for use in air pollution abatement, its odor-destroying properties were investigated on a number of malodorous organic and inorganic compounds. Reactions conditions similar to those existing in gas-scrubbing devices were employed. Threshold odor determinations before and after permanganate treatment were used for measuring the deodorizing action. Although permanganate will not destroy all odors, its spectrum of effectiveness appears to warrant its consideration as an air pollution abatement chemical, particularly since odoriferous samples from process streams of asphalt and rendering plants were successfully treated by the permanganate method. (Author abstract modified)

04664

S. Ono

ODOR PRODUCED AND ITS CONTROL BY WET SCRUBBING IN NIGHTSOIL TREATMENT PLANT. Trans. Soc. Heating, Air- Conditioning, and Sanitary Engrs. (Japan) 3, 42-7, 1965.

The aim was to reinforce existing knowledge by fundamental studies of wet scrubbing systems as odor controlling systems in nightsoil treatment plants. Experimentswere conducted to determine the effectiveness of removing H_2S and NH_3 by spray scrubbing and water film scrubbing. Water film scrubbing was more effective than spray scrubbing.

04666

I. W. Santry, Jr.

HYDROGEN SULFIDE ODOR CONTROL MEASURES. J. Water Pollution Control Federation 38, (3) 459-63, Mar. 1966. (Presented at the Texas Water and Sewage Works Short School, Texas A&M Univ., College Station, Mar. 2, 1965.)

Physical, chemical and biological procedures are discussed as methods for the control of hydrogen sulfide odors from sewers and wastewater treatment plants. Included are: venting air injection, chlorine compounds, ozone and bacteria. It is concluded that combinations of the above methods yield the best total results, and that good housekeeping practices accomplish the most economical, multi-purpose odor control.

04669

W. Strauss

ODOUR CONTROL FOR THE PROCESS INDUSTRIES. Chem. Process. Eng 46, (3) 133-7, 139, Mar. 1965.

The sources and nature of odor, as well as means of measuring odors, are reviewed. Various methods of prevention are compared: gas scrubbing, adsorption, combustion and masking. Although these approximate to chemical engineering practice in some respects, they differ markedly and these differences are examined.

04773

D. F. Adams

A SURVEY OF EUROPEAN KRAFT MILL ODOR REDUCTION SYSTEMS. TAPPI, 48 TAPPI 48, (5) 83¼A-7A, May 2965. (Presented at the Air Pollution Symposium, 148th National Meeting, American Chemical Society, Chicago, Ill., Aug. 30-Sept. 4, 1964.)

During the spring and summer of 1964, a study was made of selected kraft pulp mill installations in Norway, Sweden, Finland, France, Italy, and Austria. Information was obtained by personal interview with technical personnel in the mills and research workers in institutes and universities. Equipment in eighteen mills was observed and the unique features of these processes reported. The principal methods contributing to odor reduction included incineration, alkaline absorption, heat recovery, black liquor oxidation, and chlorine treatment. (Author abstract modified)

04781

T. T. Collins, Jr.

NEW SYSTEMS PROPOSED FOR KRAFT MILL ODOR CONTROL AND HEAT RECOVERY. Paper Trade J. 149, (22) 34-5, May 31, 1965.

Venturi scrubbing and block liquor oxidation are briefly reviewed. If oxidation is coupled with black liquor soap skimming the combination becomes a profitable proposition for increased soap yield. Using stack gas heat recovery apparatus as a part of the odor control system for the first time makes profitable a combination process for the reduction of kraft pulp mill odors. Heat recovery from stack gases coupled with black liquor oxidation and increased black liquor soap skimmings can play a profitable role in the future odor control requirements of the kraft pulp industry.00

04783

W. H. Buxton and M. W. Lapointe

CHEMICAL RECOVERY AND ODOR ABATEMENT ON A KRAFT RECOVERY FURNACE. TAPPI 48, (5) 112A-3A, May 1965. (Presented at the Pacific Section Meeting, Technical Association of the Pulp and Paper Industry, Longview, Wash., Nov. 18, 1964.)

Air pollution at Western Kraft Corp. in Albany, Ore., has been substantially reduced by establishing uniform recovery furnace control and utilizing secondary stack gas chemical recovery. Using wet gas scrubbers in conjunction with an alkaline shower wash, sodium ion collection efficiencies as high as 50% have been reported Hydrogen sulfide recovery of 90% was obtained during extensive testing. Chemical fallout in general on mill property has been reduced 94%. (Author abstract)

04861

I. B. Douglass

SOME CHEMICAL ASPECTS OF KRAFT ODOR CONTROL. Preprint. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 15, 1967.)

The kraft process, by which more than 60% of all wood pulp made in the U. S. is manufactured creates an air pollution problem by releasing methyl mercaptan, dimethyl sulfide and hydrogen sulfide to the atmosphere. Most of the problem is associated with the emission of gases from the digester, the direct evaporator and the recovery furnace. In this paper the chemistry involved in odor formation, in black liquor oxidation, and in the destruction of malodorous compounds by burning, chlorination and treatment with ozone will be discussed. (Author abstract)

04882L

National Council for Stream Improvement, Inc., New York, N. Y.

STATUS OF PRESENT INVESTIGATIONS AND FUTURE RESEARCH NEEDS IN ATMOSPHERIC POLLUTION CONTROL AT-TBull-29, 13p., June 1966.

The current status of research and technical programs concerning the kraft mill industry is reviewed. The following topics are included: (1) Analytical methods for source-gas sampling and gas-flow measurement, (2) Black liquor oxidation, (3) Absorption and oxidation of sulfur compounds, (4) Particulate emission control, (5) Meteorology and ambient-air- sampling techniques, (6) Cooperative mill service activities, and (7) Staff technical activities.

04887L

National Council for Stream Improvement, New York City.

ABSORPTION OF ODOROUS SULFUR COMPOUNDS IN CHLORINE AND CAUSTIC SOLUTIONS. (Atmospheric Pollution Technical Bulletin No. 23.) Mar. 1965. 23 pp.

The data reported herein cover the complete study on the utility of NaOH and acidic and basic Cl2 solutions as absorbents for odor producing sulfur compounds associated with kraft pulp mills. Absorption of H2S and CH3SH into aqueous solution of Cl2, NaOH, and Cl2 plus sodium NaOH was studied using a 2' diameter absorption column packed with 1/4' Intalox saddles. Absorption rates were noticeably affected by chemical reactions occurring in aqueous Cl2 and hydroxide media. Potentiometric titration methods were used to follow the reactions of Cl2 CH3SH, (CH3)2 S2, (CH3)2S in aqueous Cl2 solutions. The final product of Cl2 oxidation of H2S in aqueous solution is sulfate or collodial sulfur and sulfate. The sulfur-sulfate production ratio requires between 1.5 and 4 moles of Cl2 per mole of sulfide oxidized depending upon pH. CH3SH reacts with one mole of Cl2 forming (CH3)2S2 as a stable intermediate product. Continued Cl2 addition to aqueous acid systems results in formation of a second intermediate, probably dimethyl disulfoxide, and a final product sulfonyl chloride. In basic soltuion only disulfide is formed by the Cl2-mercaptan reaction. (CH3)2S forms sulfoxide upon reaction with Cl2 and further reactions do not appear to occur. The results of the absorption studies indicate that aqueous Cl2 solutions at a pH above 12 are effective absorbents for H2S removal in absorption equipment designed to handle sulfur in suspension. The absorption of CH3SH in aqueous Cl2 solution appeared to be impractical since (CH3)S2 was apparently the only product formed and was stripped from the tower by the gas stream. Hydroxide solution was an effective absorbent for both CH3SH and H2)s when hydroxide to sulfide or mercaptan feed ratios were greater than 1 or 1.8 respectively, and mercaptan absorption rate was twice that for sulfide absorption. (Author summary)

04943

H. L. Barnebey

REMOVAL OF EXHAUST ODORS FROM SOLVENT EXTRACTION OPERATION BY ACTIVATED CHARCOAL ADSORPTION. J. Air Pollution Control Assoc. 15, (9) 422, Sept. 1965.

Isopropyl alcohol vapor is being exhausted in 2000 cfm of air at 120 deg F from a process involving the extraction of lemon pulp by the solvent. The emission also contains trace quantities of hydrochloric acid droplets and a varying amount of particulate matter from fruit skins and peelings. The emission caused a fire hazard and was credited with a contribution to the smog problem. The rate of emission of isopropyl alcohol was 35 gallons per hour. A liquid scrubber is used to remove the particulate matter and acid fumes. The scrubber uses a 1 N sodium carbonate solution. The scrubber is followed by the activated charcoal adsorption system. This consists of two horizontal absorbers containing beds of activated charcoal, a condenser, and the necessary storage tanks, piping, valves, and controls. The solvent is removed from the charcoal bed by steam stripping and is condensed along with part of the steam. This adsorption-desorption cycle can be repeated many times per day for a period of years until the charcoal bed becomes contaminated with high molecular weight substances. The condensed dilute alcohol is concentrated in a fractionating column so that it can be reused in the process. The odor, hydrochloric acid fumes, and particulate matter are reduced to the point that they are not readily detectable. The effluent air stream contains less than 0.05 lb per hour of isopropyl alcohol. The system continuously removes and returns for reuse in excess of 95 percent of the isopropyl alcohol vapor coming to the unit. The five percent loss of solvent does not represent exhaust to the atmosphere but is mainly caused by losses in collection and in the distillation of the dilute solvent. The total operating costs for the required electrical power, cooling water, steam, maintenance, chemicals, and supervision is about one-seventh of the market value for new alcohol.

04949

J. S. Eckert

USE OF PACKED BEDS FOR SEPARATION OF ENTRAINED PARTICLES AND FUMES FROM AND AIR STREAM. J. Air Pollution Control Assoc. 16, (2) 95-8, Feb. 1966.

The principles upon which the applications of the various types of packed beds are based, as well as the applications themselves, are discussed. The packed bed originates from the classical concept of mass transfer which theorizes that the transfer of mass from a gas to a liquid phase will be controlled principally at the interface between the gas and the liquid. Although packed beds are the key part of most of the universal scrubbing equipment in present use, there are definite limitations to their application. They will remove particulate matter of 1 micron-(or larger) size by impingement. Between 0.01 to 1 micron-mean-diameter-size particles require electrostatic precipitation for efficient removal. Below 0.01 micron-size particles can again be efficiently removed by packed beds by a different mechanism where turbulence of the gas and the liquid brings the molecules or groups of molecules into intimate contact to effect a transfer from the gas to the liquid phase. Various types of scrubbers are discussed as follows: (1) Cross Flow Scrubbers operate with the gas stream moving horizontally through the bed while it is irrigated by liquid flowing downward through it. These scrubbers are useful in removing particles of 10 microns or more; (2) Counter-Current Flow beds are the most commonly used by industry. Here the irrigating liquid moves downward through the bed and the gas moves upward. These beds can develop more than one theoretical plate of transfer per unit and they use less scrubbing liquid than other types where a large amount of gas is to be removed; (3) Parallel Flow Scrubbers operate with gas and liquid progressing through the bed in the same direction and are ideal for dust laden atmospheres; (4) Co-Current Flow Scrubbers operate much as the parallel flow except that much more liquid is used per cubic ft of gas scrubbed. High pressure drop makes them useful in removal of particles down to less than 1 micron in size. The fluid flow is usually vertically downward. Odorous constituents are commonly removed by packed beds, sometimes in conjunction with adsorbents.

04950

McKean, William T., Jr., Bjorn F. Hrutfiord, K. V. Sarkanen, L. Price, and I. B. Douglas

EFFECT OF KRAFT PULPING CONDITIONS ON THE FORMATION OF METHYL MERCAPTAN AND DIMETHYL SULFIDE. Tappi, 50(8):400-405, Aug. 1968. 23 refs. (Presented in part at the 50th Annual Meeting, Technical Assoc. of the Pulp and Paper Industry, New York, N.Y., Feb. 21-25, 1965.)

Review of the available data on the formation of methyl mercaptan and dimethyl sulfide in kraft pulping allows the estimation of the kinetic characteristics of these reactions for softwood species. The summative rate of methyl mercaptan plus dimethyl sulfide formation is proportional to the initial hydrosulfide concentration in accordance with an SN2 mechanism. The formation of dimethyl sulfide from methyl mercaptan and lignin methoxyl groups appears to be subject to some unusual catalytic effects. Larger amounts of methyl mercaptan and dimethyl sulfide are produced from hardwoods than from softwoods because of a rapid initial demethylation of some labile methoxyl groups. In softwood cooks the formation of dimethyl sulfide can be reduced by short, high-temperature cooks while the temperature effect on mercaptan formation is rather insignificant. More effective reduction in odor formation is possible by lowering the sulfidity and by keeping black liquor recycle at a minimum. (Authors' abstract)

04951

Sarkanen, K. V.

EFFECT OF NEW PROCESS TECHNOLOGY ON AIR POLLUTION POTENTIAL. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: U. S. Public Health Service, National Council for Stream Improvement, and University of Florida. ((1966)), p. 311-334. 19 refs.

An ideal pulping process would selectively remove the major part of lignin (28% in conifers) and extractives of wood leaving the major part of polysaccharide components (69% in conifers) in the pulp. In the long run, sulfide-free alkaline pulping systems may well provide the ultimate solution for kraft mill odor problems. Meanwhile, the odor emission problems of existing kraft mills require more immediate attention. Several methods are already available for the efficient control of odor emissions from digester systems. The chemical recovery, including black liquor evaporation and combustion, leaves, however, much to be desired in terms of efficient odor containment. The carbonation transfer of hydrogen sulfide is proposed as an alternative to black liquor oxidation. Another approach is to stabilize the polysaccharide components to the degree of sufficient survival under the longer reaction periods necessary for delignification by NaOH alone.

04952

T. T. C. Shih, B. F. Hrutfiord, K. V. Sarkanen, and L. N. Johanson

HYDROGEN SULFIDE VAPOR LIQUID EQUILIBRIUM IN AQUEOUS SYSTEMS AS A FUNCTION OF TEMPERATURE AND PH. Preprint. 1966.

The Kraft pulping process continues to increase in importance, both as to number and capacity of mills. Concurrently, requirements are becoming ever more stringent concerning emanation of odors. In this and a subsequent paper, data are presented which are of fundamental importance to an understanding of situations in which hydrogen sulfide or methyl mercaptan may be transferred between liquid and vapor phases. Vapor-liquid equilibrium relationships of hydrogen sulfide in buffered systems are presented as a function of temperature and pH. Measurements were made by a potentiometric titration technique, at temperatures ranging from 80 to 185 C and using solutions buffered to pH values of 2, 5, 6, 7, 8, 10, 12 and 13 at 25 C. Concentrations ranged from 0.00097 to 0.0315 moles of hydrogen sulfide per liter of buffered solution. If the degree of dissociation of hydrogen sulfide is taken into consideration, it is then possible to express vapor pressure of hydrogen sulfide in equation form, in terms of temperature, concentration, and pH of the solution. New values of the first dissociation constant up to 185 C are presented.

04953

T. T. C. Shih, B. F. Hrutfiord, K. V. Sarkanen, and L. N. Johanson

METHYL MERCAPTAN VAPOR LIQUID EQUILIBRIUM IN AQUEOUS SYSTEMS AS A FUNCTION OF TEMPERATURE AND PH. Preprint. 1965.

The vapor-liquid equilibria of methyl mercaptan in buffer solutions were studied as a function of temperature and pH. Measurements were made at temperatures ranging from 80 to 135 C., using solutions buffered to pH values of 7, 8, 10, 12, 13 and 14 at 25 C., and containing from 0.00182 to 0.0451 moles per liter of methyl mercaptan. These measurements also necessitated preliminary kinetic studies of the rate of disproportionation of methyl mercaptan to hydrogen sulfide and dimethyl sulfide in alkaline solutions. An activation energy of 22.4 Kcal/g-mole was found for the reaction in one normal NaOH solution. Small corrections to the methyl mercaptan concentration were required at high concentration levels, as a result of this reaction. Vapor pressure-temperature relationships for 0.01 N methyl mercaptan solution were formulated with pH level as a parameter. Henry's Law was found to be valid for any particular pH and temperature. Henry's Law Constants, the dissociation constant and vaporization equilibrium constants as a function of temperature were calculated from experimental data. The overall expression relating the vapor pressure of methyl mercaptan to its concentration and to hydrogen ion concentration is given for dilute aqueous solutions. (Author abstract)

05093

W. Strauss

THE DEVELOPMENT OF A CONDENSER FOR ODOR CONTROL FROM DRY RENDERING PLANTS. J. Air Pollution Control Assoc. 14, (10) 424-6, Oct. 1964.

Objectionable odors associated with offensive trades, such as the rendering of meat, fish, and offal have, in the past, led to the creation of special 'offensive trades' areas, well beyond town limits. The growth of our cities, however, has surrounded the offensive trades areas with residential districts. In addition, increased demand for meat has increased throughput of offal. An important factor is that this material, which would be otherwise useless, and would have to be disposed of by burying, is converted into tallow and poultry food. This makes the design and operation of suitable plant to minimize odors of major importance to operators of rendering plants. The present paper describes a condensing plant followed by a carbon filter which has proved effective and is most economic in capital charges and operating costs. Three alternative methods for condensing the vapours investigated were: Direct spray condenser; Surface condenser with cooling water; and Air cooled fin tube condenser.

05332

A. H. Phelps

WHAT DOESN'T GO UP MUST COME DOWN. Chem. Eng. Progr. 62 (10), 37-40 (Oct. 1966).

It has been the experience of the Procter and Gamble Engineering Division that air and water pollution control must be a combined effort. Attempts to control pollution in the one realm can easily generate a problem in the other. Several short examples of the combination of problems are presented. In one of the processes where HCl is evolved in small concentrations the quantities are enough to generate a major odor or corrosion problem in the immediate area. The quantities are too small to justify any recovery, so a simple, packed water scrubber was used. The exhaust to the atmosphere is pure, but the discharge out the bottom is an acid solution which to a user is a weak solution; however, from the viewpoint of the sewer, it is quite strong. The solution to avoid a water pollution problem in this case was to neutralize the effluent from the scrubber. A rock pit filled with coarse limestone is used, discharging from there to the sewer. Other caustic solutions could be used, but in these quantities, a truck load of rock a month is all that is needed to take care of the acid. A second example arises from control of particulates. When spray drying detergents, large volumes of hot air are exhausted which contain some fine dust particles from the spray drying operation. The concentration of particulate in this gas is around 3 gr./cu. ft. and represents an economically recoverable fraction. Therefore, cyclones are used to separate the particles dry so they may be recycled back to the process. The effluent from the cyclone contains about 0.3 gr./cu. ft of even finer particles. While this would meet the air pollution code for many communities it would certainly not meet the stricter laws being written now.

05408

M. J. Matteson, L. N. Johanson, and J. L. McCarthy

SEKOR II: STEAM STRIPPING OF VOLATILE ORGANIC SUBSTANCES FROM KRAFT PULP MILL EFFLUENT STREAMS. TAPPI 50, (2) 86-91, Feb. 1967.

A pilot plant study has been carried out of the SEKOR process, which consists, in its main application, of the following elements: the continuous steam stripping with reflux of kraft pulp mill effluents to remove volatile organic compounds and the collection of the resultant bottoms and overhead streams to avoid discharging effluent volatile organic compounds into the air; the recovery of an overhead stream of water-immiscible oils; the substantial removal of volatile compounds from the condensate effluents, which reduces the hazard of water pollution should the effluent be discharged into water courses; and the recovery of a bottom stream of condensate water now purified to such a degree that often it may be reused in kraft pulp mill process operations. Experiments demonstrated that hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide were removed to a degree exceeding 95%. Operations were conducted satisfactorily using steam stripping without reflux (SENKOR-A) or with reflux (SEKOR-B). When the SEKOR-B process was used under appropriate conditions, nearly all of the volatile organic compounds were collected in the water-immiscible overhead stream.

05409

B. F. Hrutfiord and J. L. McCarthy

SEKOR I: VOLATILE ORGANIC COMPOUNDS IN KRAFT PULP MILL EFFLUENT STREAMS. TAPPI 50, (2) 82-58 Feb. 1967.

As part of a program of development of a process for stripping aqueous effluents for kraft pulp mill odor reduction (SEKOR), a study has been made of the volatile organic compounds that may be steam-distilled from kraft pulp mill effluent liquors. Some compounds have been isolated and characterized by gas chromatography. The materials studied include an oil isolated from blow gas condensate, an aqueous blow gas condensate, and several crude sulfate turpentines. Compounds identified include hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyldisulfide, methanol, ethanol, acetone, methyl isobutyl ketone, alpha-pinene, beta-pinene, delta 3- carene, camphene, limonene, cineole, and alpha-terpineol. A large number of additional compounds have been detected. Turpentines from a number of sources have been analyzed and compared. (Authors' abstract)

05490

K. J. Springer

AN INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE. PART I. (FINAL REPT.). Southwest Research Inst., San Antonio, Tex., Vehicle Emissions Research Lab. Mar. 1967. 644 pp.

This investigation was concerned with noticeable levels of diesel smoke and odor both from two-cycle powered city buses and four-cycle powered intercity trucks. The program included field studies, development of facilities and procedures, study of vehicle variability, and investigation of two techniques for smoke reduction. Result of field studies indicated that the two-cycle powered bus odor and smoke were grossly different from the four-cycle powered truck. Reasonable atmospheric dilution levels from a typical horizontal bus exhaust were found to range from 100:1 to 1000:1, whereas the dilution levels from a vertical exhaust stack equipped truck ranged from 700:1 to 7000:1. These results permitted realistic simulation of field operation in a specially designed laboratory odor and smoke measurement facility. The odor measurement method involved simultaneous exposure of a panel of ten persons to a dynamically diluted sample of diesel exhaust. A diesel odor evaluation kit, composed of an overall diesel odor and four different qualities at various intensities, was used as a reference by the panel. Smoke was measured by means of a PHS smokemeter under both constant speed and accelerating type vehicle conditions. Utilizing these measurement methods, chassis dynamometer, panel and smokemeter procedures were developed for the city bus (five odor and six smoke conditions) and for the intercity tractor (six odor and seven smoke conditions). The trained panel was able to relate the effect of dilution, load, and other operating parameters to the quality/intensity of the dilute sample. These conditions and procedures were then employed to measure the smoke and odor variability from ten similar buses and ten similar trucks. Limited investigations of fumigation and dilution resulted in only a partial or technical success.

05532

A. Lieberman

FINE PARTICLE TECHNOLOGY IN THE CHEMICAL PROCESS INDUSTRIES. PART I. Chem. Eng. 74,(7) 97-102, Mar. 27, 1967.

The two main topics of this review are: (1) how the physical and chemical properties of very fine particles (ranging from about 0.05 to 100 microns) affect manufacturing processes; and (2) how fine particles, solid and liquid, are produced. In the first category, the manufacture and processing of foods, drugs, pigments, metals ceramics and many other materials is affected by particle properties. For example: rates of reaction can be controlled by available concentration of one of the reactants which can be in- creased by extending the surface of subdivision; the handling of powders, etc., may involve considerations relating to flammability and explosive limits; power required for bulk handling can be re- duced by including a range of particle size; particle size of stack emissions will affect visibility of the exhaust plume. Op- tical properties (opacity, light scattering, etc.) can be con- trolled by particle size limitations. Other properties involving fine particle technology, discussed briefly, are shape, electrical nature and magnetism. Hazards of particle inhalation can be con- trolled by particle size considerations, i.e., where particles from 35 to 5 microns are captured in the upper respiratory passages from 5 to 1 microns are retained in the alveoli, particles from 1 to 0.1 microns tend to be exhaled and those smaller than 0.1 microns tend to be captured and retained. Brief discussion of the production of particles includes, for solid particles: crystallization, spray drying, gas-phase reactions, high-energy discharges, and flame decomposition; and for liquid particles: conventional atomizers, nozzle atomizers, spinning-disk atomizers, ultrasonic atomizers, elect*ostatic atomizers, vapor condensation and emulsification.

05624

W. Summer

ODOUR DESTRUCTION (TECHNICAL AND LEGAL ASPECTS AND HOW THEY AFFECT THE VENTILATING ENGINEER). J. Inst. Heating Ventilating Engrs. (London) 34, 229-36, Nov. 1966 and Public Health In- spector, 75:(7):291-300, Apr. 1967. (Presented at a Sessional Meeting, Inst. of Heating and Ventilating Engineers, London, England, Dec. 8, 1965.)

Destruction of odors by oxidation with nascent oxygen is reviewed, in contrast to masking or neutralizing by addition of another odoriferous material. The nascent oxygen is produced by ultra- violet irradiation of the polluted air, preferably in an expansion chamber providing a 6 to 8 sec. residence time. Design criteria for the 'odourless factory' are given and examples of application described.

05808

F. E. Murray

REACTIONS OF SULFUROUS AIR POLLUTANTS. ((British Columbia Research Council, Vancouver, Canada)). May 12, 1967. 88 pp.

The object of the work was to generate information on the reactions of methyl mercaptan, methyl sulfide, methyl disulfide and the reaction between hydrogen sulfide and sulfur dioxide - all in the gas phase. It was a further object of the studies to devise methods, using the information gained, for modifying these compounds by chemical reaction to alleviate the odorous air pollution from kraft pulp mills. Reactions in the gas phase were conducted between oxygen and methyl mercaptan, methyl sulfide and methyl disulfide both with and without catalysts. The reaction between hydrogen sulfide and sulfur dioxide in the gas was the subject of a preliminary study. The work done and the apparatus used is described in the following publications which form an Appendix to this report: (1) Gas Phase Oxidation of Methyl Mercaptan, A. C. Harkness and F. E. Murray, Air and Water Pollution, Int. J. v. 10, pp 245-251 (1966); (2) Gas Phase Oxidation of Methyl Sulfide, A. C. Harkness and F. E. Murray, Air and Water Pollution, Int. J.; (3) Method of Analyzing the Effluent from a Microreactor, L. T. Girard and A. C. Harkness; (4) Catalytic Oxidation of Sulfurous Air Pollutants, A. C. Harkness, F. E. Murray and L. T. Girard; and (5) Application is being prepared for patent coverage on the catalytic oxidation of the organic sulfides. From the results on catalytic oxidation, a large-scale experimental reactor packed with iron shot was assembled and studies are continuing at a local pulp mill. It appears to be a very promising approach to the oxidation of organic sulfur compounds in the gas phase. One of the principal advantages seems to be that no explosions or tendency to explosions have occurred in the catalytic reactor.

05852

R. J. Reed and S. M. Truitt

SELECTING INCINERATOR SMOKE AND ODOR BURNERS. Air Repair 4 (3), 109-17 (Nov. 1954).

A method for controlling smoke and odor emission by flue-fed incinerators is discussed. The burning process, the differences from industrial and municipal incinerators, a solution using an auxiliary gas diffusion flame, the selection and location of burners, a case history of an approved installation, settling and combustion chambers, the luminous flame burner, starting procedure, and recently announced installations are considered. A discussion and the authors' replies are included.

05862

J. E. Molos

CONTROL OF ODORS FROM A CONTINUOUS SOAP MAKING PROCESS. J. Air Pollution Control Assoc. 11 (1), 9-13, 44 (Jan. 1961). (Presented at the 53rd Annual Meeting, Air Pollution Control Association, Cincinnati, Ohio, May 22-26, 1960.)

A semi-residential neighborhood in south St. Louis suddenly, in the spring of 1957, became a focal point of air pollution complaints. Tracing the odor from the points at which it was faint to the area where it was pronounced, suggested strongly that a soap plant, which had been located in the neighborhood for many years, was the source of this odor. It was found that the company had been a formulator of soap compounds for many years at its present location. To soap which had been manufactured elsewhere were added modifiers, perfumes, etc., to get finished products. The company subsequently decided to manufacture its own soap and installed a unique, continuous, countercurrent, three-stage process to make neat soap from coconut oil, tallow, soybean and cottonseed soap stocks. A large spray drier was erected to make granulated soap from the neat soap. Break-in processing with the new equipment commenced in the spring of 1957, exactly coinciding with origination of complaints. The fishy odor appeared due to the presence of low boiling point amines which were not effectively scrubbed out in the boric acid scrubber. The ultra-centrifuges appeared to create oil aerosols which seemed to act partially as a carrier for the amines. It is, however, quite possible that the formation of the oil aerosol and the escape of the amines were quite independent of one another. The described control systems resulted in relatively odorless conditions in the neighborhood of the plant for several months. There were two brief breakdowns both based on the extremely cold weather experienced. Steps were taken to prevent recurrence of these breakdowns under similar or even more extreme weather conditions. With these exceptions, one could drive by or walk around the plant without detecting any fishy odor.

05880

V. P. Owens

CONSIDERATIONS FOR FUTURE RECOVERY UNITS IN MEXICAN AND LATIN AMERICAN ALKALINE PULPING MILLS. Combustion 38 (5), 38-44 (Nov. 1966). (Presented at the Sixth Annual Meeting, Asocion Mexicana de Tecnicos de las Industrias de Celulosa y del Papel A. C., Mexico City, Mex., May 24-28, 1966.)

Air pollution is a major problem in recovery unit operation because the recovery unit produces the largest volume of gases discharged to atmosphere. For many years electrostatic precipitators have been installed after recovery units to remove the chemical fume in the gases. The gas is heavily laden with submicron size particles which is condensed sodium vapor formed in the furnace. Several mills are working with venturi-scrubber installations to improve collection efficienceies in operation. Oxidation of black liquor is becoming a 'must' for mills that hope to reduce the odor nuisance to a tolerable limit. In the future, efforts will be concentrated on the analysis of sulfur compounds in the flue gases. Good kraft-recovery-furnace operation demands a deficiency of air through the primary-air ports for good reduction performance. Under these conditions hydrogen sulfide is formed in the lower furnace. Sulfur oxides formed in combustion of a black liquor will react with the sodium oxide to form salt cake and prevent sulfur loss from the furnace in this form. Direct- contact evaporators, either the cascade or the cyclonic type use the flue gases for evaporation of the water in the liquor to increase concentration from the approximately 50 per cent level to 60-70 per cent dry solids. This is the prime source of odor when black liquor is not oxidized before direct- contact evaporation. Oxidation converts the sodium sulfite to a stable form, usually sodium thiosulfate. Direct-contact evaporators can be removed by designing multiple-effect evaporators for 60 per cent dry solids for feed directly to the furnace.

05929

W. S. Tyler

CATALYTIC OXIDATION OF ODOROUS INK SOLVENT VAPORS. ((Proc. Tech. Conference, Mid-Atlantic States Sect., Air Pollution Control Assoc., Newark, N.J.,)) 1-7 (1962).

This article reports the engineering approach to the development of controls for fumes emitted during high speed printing opera- tions. It was found that the kerosene-like solvent used was being partially oxidized to irritating and obnoxious aldehydes by the severe drying conditions, i.e., hot circulating air blast of 650 - 700 F. After pilot plant runs to test catalytic oxidation, it was concluded that 30 to 40% of the recirculated solvent vapors were oxidized to objectionable materials without a catalyst being present, and with one present, 90 to 95% of the solvent vapors being recirculated were converted to unobjectionable CO2 and water. With this encouraging information, the Pt catalyst installation was made. A second installation provided a six deep catalyst bed of half the original cross sectional area. This not only evened out the flow across the bed but appeared to improve efficiency as evidenced by increased temperature rise across the catalyst. Location of the catalyst in the circulating systems has the disadvantage of using about 4 times as much catalyst as would be required in the stacks with their much smaller fans. This disadvantage is more than compensated by the simplicity of operation and the fuel gas economy. Catalytic oxidation not only reduces the partly oxidized hydrocarbons discharged but also the amount of tar formed in process.

05930

Massiello, J.

AIR POLLUTION CONTROL AT DREW CHEMICAL CORPORATION. Proc. Tech. Conference Mid-Atlantic States Sect., Air Pollution Control Assoc., Newark, N. J., 1962. pp. 8-12.

The installation of equipment to reduce air pollution in the chemical processes involved in edible oil refining and byproduct manufacture is discussed. In the initial refining of oils when the soap stock is separated, the oil must be dried under vacuum and bleached. This resulted in entrainment particles of oil discharged to the atmosphere. This pollution was eliminated by changing the design of the vacuum system and installing a surface condenser before the steam jet, which condensed the steam and stopped 99 percent of the oil mist carry over. The different design of the vacuum system resulted in a steam savings that paid for the installation in a period of two years. The new design also resulted in a better vacuum. In the next step of processing, oils are deodorized by blowing steam through the oil under high temperature and 1 millimeter of absolute pressure. The possible pollution of the atmosphere by evaporation and entrainment of water laden with oil was counteracted by installing an extra set of eliminators in all cooling towers reducing entrainment into the atmosphere by about 75 percent. A centrifuge for cooling tower waters to continually centrifuge out oil thereby reduces the air pollution due to residual entrainment. Other control equipment included: wire mesh demisters; a rachis ring caustic scrubber; a large tangential separator and an air cooling baffled condenser in series; extra eliminators in the cooling towers; a centrifuge. Controls for utilities emissions are also discussed. In summary $250,000 has been spent on the various air pollution control devices. Expenditure of another $50,000 is anticipated for the next year.

06088

J. L. Mills, W. F. Hammond, R. C. Adrian

DESIGN OF AFTERBURNERS FOR VARNISH COOKERS. J. Air Pollution Control Assoc. 10 (2), 161-8 (Apr. 1960). (Presented at the 52nd Annual Meeting, Air Pollution Control Association, Los Angeles, Calif., June 21-26, 1959.)

The airborne discharge from varnish cookers is particularly difficult to control because it consists of varying mixtures of solid particles, liquid droplets, condensable vapors and volatile vapors. Two most widely used methods of control, scrubbing and combustion, leave the odor problem unsolved. This report concerns the design characteristics of direct-fired afterburners which were constructed to destroy these air contaminants produced during varnish cooking. Results show that the pollution problems from oil bodying and varnish cooking in batch type vessels can be adequately and economically solved by direct incineration of the combined particulate and gaseous pollutants. In designing a control system, the following items should be considered: 1. Hooding. Hoods should be tight-fitting to assure adequate mist capture with minimum airflow. Ease of cleaning is a critical consideration because of the danger of batch spoilage from dripping condensate. 2. Duct work. Ducts should be sloped away from the hoods and spots should be eliminated or provided with drainage. 3. Flashback protection and precleaning. A water spray leg is recommended for precleaning and flashback protection. 4. Afterburner. The afterburner should be designed for a minimum gas temperature of 1200 F with a capability of being operated at 1400 F and should provide for intimate mixing of the gas stream with a luminous flame. The combustion chamber should be refractory-lined and should provide for a residence time of 0.5 second. The velocity of the gases through the chamber should not be less than 15 fps. 5. Controls. Burner controls should be of the modulating type to insure continuous and uninterrupted flame coverage in the combustion chamber.

06103

A. J. Teller

ODOR ABATEMENT IN THE RENDERING AND ALLIED INDUSTRIES. J. Air Pollution Control Assoc. 13 (4), 148-9, 166 (Apr. 1963). (Presented at the 55th Annual Meeting, Air Pollution Control Association, Chicago, Ill., May 20-24, 1962.)

In feasibility studies of odor abatement it was decided that an integration of pollution abatement components within the process system might reduce the economic burden to an acceptable level. Systems were designed for the three different types of rendering operations. Two have been operating for a satisfactory evaluation period and a third will be on-stream in the near future. It was found that the problems of the pollution abatement could be divided into four basic areas. (1) Cooker and cooker vapor control; (2) Drier effluent treatment; (3) Restriction of product dumping areas; and (4) Solvent recovery systems. Of the four basic areas of control the solvent recovery can be considered as the only one where early payout can be achieved. It was felt, however, that integration of the pollution abatement control system with the actual process equipment would reduce the actual cost of pollution abatement. Adsorption was chosen as the odoriferous gas removal process for the cooker system because of the low cost of activated carbon, its high capacity for organic compounds, and the simplicity of the process. The combination of all vapor streams in the condensation operation resulted in a capital investment of the same magnitude as that for individual condensers. Thus the net cost of capital equipment for pollution abatement was still nil. In addition, via modulated control of water feed for condensation, insignificant savings of water are achieved when compared with continuous full flow condensers used with individual condensers. The savings of water consumption will vary significantly as a function of plant location. The pollution abatement expense costs total $550 per year compared with a savings in water consumption costs of the same magnitude based on river water use. The net cost of installation and operation of a pollution abatement system is, therefore, essentially zero for this integrated installation. In the case of urban installations, considerable savings are obtained. Additional benefits other than that of pollution abatement have been observed as a result of operation at pressures slightly below atmospheric.

06106

R. H. Wright

NEW WORK IN KRAFT MILL ODOR CONTROL. (J. Air Pollution Control Assoc.) 13 (3), 101-4, 136 (Mar. 1963). (Presented at the 55th Annual Meeting, Air Pollution Control Association, Chicago, Ill., May 20-24, 1962.)

Procedures for the control of odor in the kraft pulping process are reviewed. The theory behind black liquor oxidation is that when the hot liquor is brought in contact with air, the sodium sulfide is oxidized to sodium thiosulfate and the methyl mercaptan is converted to dimethyl disulfide, resulting in reduction of the more odiferous compounds. If the oxidation tower is situated so that the black liquor passes through it before going to the multiple-effect evaporator the odor released is eliminated or very greatly reduced. Thus, in a mill using black liquor oxidation, the most serious remaining sources of odor are, in order of decreasing importance, the recovery furnace, the direct contact evaporator, and the air exhausting from the oxidation towers. With a properly designed and operated furnace the flue gas should contain no significant amounts of H2S or other reduced sulfur compounds. In principle, a sufficiently complete prior oxidation of the black liquor will prevent the furnace gases from picking up any malodors in the direct contact evaporator, apart from substances like dimethyl sulfide which are not acidic and not retained by alkali. One may be forced to carry out the black liquor oxidation in two stages, using a partial oxidation of the weak liquor and finishing off the reaction after the liquor has been partially evaporated. An alternative is to do away with the direct contact evaporator entirely. The elimination of the direct contact evaporators can confer an over-all operating benefit in the form of heat economy, but at the cost of a substantial increase in complexity. The balance of advantage from this has to be worked out by each mill for itself. In the oxidation tower exhaust gas process a two-stage process has been developed for the absorption and oxidation of the malodorous substances in the oxidation tower exhaust gas, using a gas-liquid reactor. The gases are first exposed to chlorine solutions of low pH so as to absorb and oxidize the sulfur compounds to innocuous products. Then a solution of pH about 8 is used to absorb any residual chlorine or acid products of the oxidation. Kraft mill odor control measures are still by no means complete or fully effective. Black liquor oxidation is not a complete answer, though it would be difficult to imagine an effective control system that did not include it.

06280

Folke Hedlund, Gustav Ekberg, Sten Erik Mortstedt

DIESEL EXHAUST GASES. INVESTIGATION WITH PROPOSALS FOR ACTION. (Communications Dept., Stockholm, Sweden, Guidance Group Concerning Development Work in the Field of Motor Vehicle Exhaust Gas, Sept. 1967. Translated from Swedish. Joint Publications Research Service R-8943-D, 74p., Dec. 12, 1967. 27 refs.

Diesel exhaust emissions and methods of controlling these emissions in Sweden are reviewed. The diesel engine differs from the gasoline engine in several respects, which have a decisive influence on the pollution it emits. It uses a fuel that is less volatile than gasoline. It normally works with a higher excess of air (leaner mixture) and the devices for feed and ignition of the fuel are quite different. Due to the discharge by individual vehicles of dense smoke and by the discharge of foul-smelling substances they have been pointed out by the public as qualified air polluters. Poor maintenance of the engine or intentionally wrong pump adjustments can result in the giving off of such dense smoke that this can constitute a hazard for overtaking vehicles due to impaired or obscured visibility. Diesel engines can give off various types of smoke. One type is the heavy load smoke, which arises through load on a hot engine. Exhaust gases from diesel vehicles, especially under certain driving conditions, contain substances that are irritating to eyes, nose and throat. These include: oxides of nitrogen, hydrocarbons, polycyclic aromatic hydrocarbons, carbon monoxide and sulfur dioxide. The smoke from a diesel engine can be limited by various measures, undertaken on the engine or the fuel pump, the fuel, and finally on the exhaust gases. Regular maintenance of the engine is necessary to keep the smoke values at the lowest possible level. Current and proposed regulation of diesel exhaust emissions are discussed.

06363

F. J. Anderson H. S. Posselt

PERMANGANATE OXIDATION OF SULFUR COMPOUNDS; APPLICATION TO AIR SCRUBBING. Preprint. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11, 1967, Paper No. 67-114.)

The oxidation of thio compounds by permanganate in terms of stoichiometry, oxidation products and relative rates to determine its effectiveness in destroying the odoriferious sulfur functional group was examined. From the general classes of thiols, sulfides, disulfides and sulfoxides, only the lower molecular weight -- more volatile -- compounds were studied. Because of their volatility, these compounds, or compounds of similar functionality, might be expected to be found in process gas streams. Permangante has proved useful in scrubbing various process gas streams; the results obtained in this study demonstrate the usefulness of permanganate in removing sulfurous compounds from gas streams. (Author abstract modified)

06366

David M. Benforado, Joseph Waitkus

FUME CONTROL IN WIRE ENAMELING BY DIRECT-FLAME INCINERATION. J. Air Pollution Control Assoc., 18(1):24-26, Jan. 1968. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967.)

The results of source tests to demonstrate the applicability of direct-flame incineration for the control of the effluent from a wire-enameling bake oven are presented. The tests were conducted with a portable direct-flame incinerator under actual plant conditions. The efficiency of direct-flame incineration was established at incineration temperatures of 1000, 1200, and 1400 deg F. Evaluation of incineration efficiency was performed by both analysis and quantitative odor measurement using an odor panel. (Authors' abstract)

06412

J. L. Mills, J. A. Danielson, L. K. Smith

CONTROL OF ODORS FROM INEDIBLE RENDERING AND FISH MEAL REDUCTION IN LOS ANGELES COUNTY. Preprint. (Presented at the 60th Annual Meeting, Air Pollution Control Association, Cleveland, Ohio, June 11-16, 1967, Paper No. 67-10.)

Control equipment for the counteraction of odors emitted during the reduction processes at rendering plants and fish meal reduction plants were described. The condenser-afterburner odor control system and chlorinator-scrubber odor control system are used to control odors from the rendering cooker and fish meal dryer, respectively. Both systems reduce these prominent odors by nearly 100 percent. When these main sources have been controlled, further reductions of odors from reduction plants can be achieved using similar control devices on other sources such as expellers, centrifuges, heated tallow processes, fish oil defatting equipment, etc. Lastly, but of equal importance, is a good housekeeping program incorporating a thorough washdown of equipment and floors each working day, and a conscientious maintenance program for the equipment, which is constantly subject to severe corrosion.

06453

K. J. Springer

INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE - PART 2 (MONTHLY PROGRESS REPT. NO. 3, MAR. 15 - APR. 15, 1967). Southwest Research Inst., San Antonio, Tex., Vehicle Emissions Research Lab. 12 pp. (May 3, 1967).

The fleet test of a smoke suppressant additive began on April 1 and is currently in progress. The initial tests indicate that the smoke suppressant additive was effective in reducing visible exhaust smoke. The investigation of the effect of the Jacobs engine brake on exhaust smoke and odor from a two-cycle powered bus is under way. A plan of test has been formulated for the evaluation of the three types of catalytic mufflers for installation on two-cycle powered municipal buses. Clarification of the exhaust gas constituents of primary interest and their method of analysis for correlation with human odor panel responses has been obtained.

06525

K. J. Springer

INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE - PART 2 (MONTHLY PROGRESS REPT. NO. 5, MAY 15 - - JUNE 15, 1967). Southwest Research Inst., San Antonio, Tex., Vehicle Emissions Research Lab. (July 1, 1967). 102 pp.

The results are presented of the investigation of the effect of engine derating on smoke and odor using the Detroit Diesel 6-71 N and Cummins NH-220 powered truck-tractors. The fleet test of a smoke suppressant additive has completed two months of operation. Initial experiments were under way using a variety of gas chromatography columns, sampling methods, and procedures to determine the feasibility of relating an instrumental technique with the human panel responses.

06636

Bureau of Mines, Washington, C.C.

AIR POLLUTION RESEARCH PROGRESS REPORT FOR THE QUARTER ENDED MARCH 31, 1968. In cooperation with the Public Health Health Service.) (Mar. 31, 1967) 87 pp.

This report covers progress on research in the folloring areas: Sulfur dioxide removal from flue gas; Removal of sulfur oxides from flue gas with manganese oxide and improved regeneration; Economic evaluation of processes for the removal of sulfur dioxide from flue gas; Characteristics and removal of pyritic sulfur from selected American coals; Pollution by chlorine in coal combustion; Flame characteristics causing air pollution; Characteristics and photochemical reactivity of vehicular emissions; Mechanisms of air pollution reactions; Effects of engine, fuel and combustion system parameters on vehicular emissions; Composition, smoke and odor of diesel exhausts.

06688

W. S. Sease and G. F. Connell

PUT OZONE TO WORK TREATING PLANT WASTE WATER. Plant Eng. 20 (11), 126-7 (Nov. 1966).

Ozone is an extremely versatile chemical used for water treatment, and waste, odor and air pollution control. In natural states it occurs in concentrations of 0.01 - 0.02 ppm by volume. Of all the methods of commercial production, corona discharge is the most successful technique for industrial application. In generating ozone, a minimum voltage of 1500V is impressed upon a conductor. Between conductor and ground, there is a non-conductor and an air gap. The corona discharge occurs in this gap. Concentrations of 1% by weight, or 6000 ppm by volume can be produced on a consistent and practical basis. Ozone, as an oxidizing agent, purifies water from organic matter, bacteria and viruses and facilitates filtering of solvable ferrous and manganese salts. In waste treatment plants which employ primary and secondary systems for waste removal, ozone provides the tertiary or final polishing treatment of the effluent. Properly handled, toxicity of ozone presents no greater problem than any normal compressor or motor.

06859

I. S. Shah

NEW FLUE-GAS SCRUBBING SYSTEM REDUCES AIR POLLUTION. Chem. Eng., 74(7):84-86, March 27, 1967.

A new two-stage scrubbing system is described which consists of evaporator, scrubber, separator and cooling tower in which 99% cleaner and 500-600F cooler. Two oxidation systems are utilized, one for weak black liquor and the other for strong black liquor. The latter is installed immediately after the multiple effect evaporator. Air oxidation of black liquor decreases the loss of hydrogen sulfide because oxygen converts Na2S to less volatile forms that minimize release of sulfur-bearing gases.

06979

K. J. Springer

INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE - PART 2 (Monthly progress rept. No. 6, June 15-July 15, 1967). ((Southwest Research Inst., San Antonio, Tex., Vehicle Emissions Research Lab.)) (Aug. 1, 1967). 17 pp.

The evaluation of the catalytic mufflers for use with two-cycle powered city buses has begun. An investigation of the effect of adding fresh air to exhaust valves of a two-cycle powered municipal bus has been completed with little beneficial effect on odor and smoke noticed. The five-truck fleet test of a smoke suppressant additive is continuing satisfactorily. The preliminary feasibility study of an instrumental technique for correlation with odor panel response is in progress. (Author's abstract)

07224

E. Fiala and E. G. Zeschmann

THE EXHAUST GAS PROBLEM OF MOTOR VEHICLES (PART 2). Zum Abgasproblem der Strassenfahrzeuge (Teil 2). Automobiltech. Z. (Stuttgart) 67(12), 419-22 (Dec. 1965). Ger.

The CO content of cigarette smoke was determined by means of the Orsat apparatus and the Draeger probe. The CO concentration varied between 2 to 5% which is about ten times the concentration in the engine exhaust gas of an automobile cruising at constant speed. The origin of unpleasant odors of two-stroke engines was traced back to strongly heated hydrocarbons forming aldehydes. The effects of various adjustments of the carburetor on the CO concentration were determined. Optimal positions of the choke plate and other adjustable parts of the carburetor were determined for some compact cars. Photographs illustrate the experimental set-up, and results are presented in graphs. Ignition limits of mixtures of air, nitrogen, and n-heptane were determined. The exhaust gas composition can be improved considerably with little effort if the loss of some peak power is tolerated.

07362

Feist, H. J.

ELIMINATING ODORS BY CATALYTIC COMBUSTION. ((Die Geruchsbeseitigung durch katalytische Verbrennung.)) Text in German. Stadtehygiene (Uelzen/Hamburg), 16(3):55-61, Mar. 1965. 11 refs.

With the rapid growth of the chemical industry, air pollution by odors has also increased. Catalytic oxidation and reduction offer possibilities for an economic solution of the problem. The principles of catalytic reactions are described. In a table the properties of four catalysts are compared with each other. These catalysts are: platinum on metal, platinum-palladium on ceramics, copper-chromium on aluminum oxide, and platinum on ceramics. The effectiveness of a catalyst depends on the gas mixture, the temperature, the type of catalyst, and the ratio: volume of gas/hour/volume of catalyst. The heat generated by the catalytic process is usually used to preheat the gas before it enters the catalyst. If the concentration of combustible substances is sufficient, steam may be produced in addition. An example is quoted where 47,000 cu. m. gas per hour with a latent heat of 400 kcal/cu. m. produce 31 tons of steam per hour. The equipment pays for itself in 2 1/4 years. For gases of low heat content, catalytic combustion under increased pressure is advantageous. Most economical is a gas turbine which compresses the gas and, after it has passed the catalytic chamber, uses the hot cleaned gas. The use of a gas turbine is recommended for gas volumes of more than 100,000 cu. m./hr, if measures for air pollution control become necessary.

07374

Hettche, H. O., H. Schwarz, and W. Luhr

WASTE GAS CLEANING IN THE ANIMAL PRODUCTS INDUSTRY. PART 3. ((Abgasreinigung in der Industrie Tierischer Produkte. Teil 3.)) Text in German. Stadtehygiene (Uelzen/Hamburg), 15(9):210-212, Sept. 1964.

The dimensioning of a spray tower simultaneously operating as a jet pump is described. For a fish meal plant, a scaled down version of three spray towers in tandem was built. The first tower worked with water/steam, the second with NaOH and NaOCL, TOWER WORKED WITH WATER/STEAM, THE SECOND WITH NAOH AND NAOCL, and the third with H2SO4. Necessary pump power, water volume, and the quantity of chemicals were determined. From these data the relevant figures for the full size plant were derived. Some of the figures quoted are for a plant producing 10 tons of fish meal per hour. For example, the pumps have a power of 24 kW, and 110 cu. m. cooling water per hour are needed. The factors influencing the efficiency of a spray tower are discussed in detail .

07415

Blosser, R. O., and H. B. H. Cooper, Jr.

TRENDS IN REDUCTION OF SUSPENDED SOLIDS IN KRAFT MILL STACK. Paper Trade J., 151(11):46-51, Mar. 13, 1967. 6 refs.

A survey of secondary wet scrubbing practices showed that relatively low pressure drop devices may produce a 50 per cent 3 80 per cent reduction in particulate emission from precipitator streams. The per cent reduction is somewhat less where these devices are employed behind Venturi recovery units. Removal efficiency was observed to be independent of the type of scrubber used behind precipitators at the inlet loadings observed. Final effluent quality was related directly to scrubber inlet grain loading. Effective scrubbing has been shown to reduce particulate fallout in the area adjacent to mills. Scrubbing may reduce particulate emissions to the atmosphere, but may also reduce the height of plume rise, hence dispersion is reduced and an odor problem may be accentuated. It is difficult to predict that any real benefit in either fallout or total emission is obtained at the low loadings found behind some of the new high efficiency precipitators. This suggests that schemes which assure essentially continuous operations of these units in a good state of repair may be as advantageous as wet scrubbing. (Authors' summary)

07429

A. H. Phelps, Jr.

AIR POLLUTION ASPECTS OF SOAP AND DETERGENT MANUFACTURE. J. Air Pollution Control Assoc., 17(8):505-507, Aug. 1967.

The spray drying of synthetic detergents is the major source of particulate emissions. Suitable control equipment utilized during trhe drying process is discussed. There will be up to three grains of particulate/standard cu ft in the hot, humid tower exhaust gas. The fines comprise an economically recoverable portion and cyclones would usually be provided to collect this material and return it dry to where it may be recycled. Dry collection devices are desired here so that the product may be returned directly to the process. The cyclones are high efficiency, high-pressure drop cyclones with a pressure drop across them of about 8-10 in. of water and have an efficiency of between 90 and 95%. After the cyclone, the gas will sually contain about 0.3 grain of dust/standard cu ft, although this figure will vary depending upon the efficiency of the cyclones and their inlet concentrations. Control between the cyclone and the exhaust will vary depending upon the source of emission with respect to boundary lines, and the nature of the surrounding community. This fallout can be controlled rather easily by devices as crude as a simple spray chamber without packing, although packed scrubbers and venturi scrubbers are used. The dust at this concentration is not exonomically recoverable and thus, a wet collector is a suitable application. Some misoperations which may cause air pollution problems are also covered.

07434

E. Thomas, S. Broaddus, E. W. Ransdell

AIR POLLUTION ABATEMENT AT S. D. WARREN'S KRAFT MILL IN WESTBROOK, ME. Tappi, 50(8):81A, Aug. 1968. (Presented at the 52nd Annual Meeting, Technical Association of the Pulp and Paper Industry, New York City, Feb. 19-23, 1968.)

Sources of gas emission in a kraft mill were studied and corrective equipment was installed. A system was developed in which digester blow gases are passed through primary and secondary deodorizing scrubbers, utilizing the chlorination stage effluent. As backup, weak hypo bleach can be added to the secondary unit. Noncondensable digester relief gases are burned in the lime kiln. Oxidation control instruments have been installed on the two recovery boilers to ensure complete combustion. Number 1 recovery boiler stack has a Cottrell precipitator, and a venturi scrubber is on no. 2. Both recovery boilers have scrubbers on their smelt tank vents. Black liquor is presently oxidized in a Trobeck-Lundberg- Tomlison oxidation tower before passing to the evaporators. Chemical tests are performed daily to determine the efficiency of black liquor oxidation. Periodic surveys are conducted on all suspected sources of air pollution ot determine the effectiveness of this abatement program.

07479

Springer, K. J.

INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE. PART 2. Southwest Research Inst., San Antonio, Tex., Vehicle Emissions Research Lab., PHS Contract No. PH 86-67-72, Mon. Progr. Rept. No. 7 ((184)) p., Sept. 1, 1967. 3 refs.

The effectiveness of several exhaust catalytic devices on odor and smoke from diesel powered city buses was determined. The devices were installed on municipal buses operated by the San Antonio Transit System fleet and put into routine operation. After a period of time the buses were taken out of service and the measurements of odor, smoke and selected chemical and physical parameters were obtained. These evaluations were made with the catalytic muffler installed and then with the stock muffler installed. Preliminary results indicate that the effectiveness of these two identical GM mufflers may not be as significant as may have been expected, although some differences were noted. Secondly, the effect of exhaust manifold oxidation on odor and smoke emissions from a two-cycle powered municipal bus was determined. The system injects fresh air at the underside of each exhaust valve in an attempt to partially or further oxidize various exhaust constituents under maximum available exhaust heat conditions. The results of these initial investigations indicated that addition of fresh air at the underside of the exhaust valve noticeably reduced the visible smoke. The experiments were conducted under maximum power output high engine speed conditions. Thirdly, the Jacobs engine brake, which tends to remove soot and carbon build-up in the combustion chamber and exhaust ports as well as keep the exhaust manifolds clean was studied. The last fifty buses were equipped with Jacobs engine brakes and a bus was randomly selected from this group of vehicles for purposes of evaluating the effectiveness of the Jacobs engine brake on the odor and smoke emissions from a two-cycle powered municipal bus. Little beneficial effect on diesel odor was noticed when the Jacobs brake was operative versus when it was disconnected. Fourthly, a fleet test was performed on five similar truck-tractors operating on a fuel which had been treated with a commercial smoke suppressant additive. The additive treatment method employed was recommended by the Lubrizol Company. The treatment level of 565 additive, prediluted in equal parts of kerosene to promote mixing, is 0.5 percent by volume of the base fuel. The smoke suppressant additive is apparently effective in all trucks under both constant speed and transient acceleration smoke measurement conditions.

07530

H. O. Hettche, H. Schwarz, W. Luhr

WASTE GAS CLEANING IN THE ANIMAL PRODUCTS INDUSTRY - PART I. (Abgasreinigung in der Industrie Tierischer Produkte - Teil I.) Text in German. Stadtehygiene (Uelzen/Hamburg), 15(5):103-104, May 1964.

Complaints by the neighborhood of a fish processing plant about annoying odors led to a series of experiments to determine an economical way for cleaning the plant's waste gas. Drying of fish meal can be done in three ways: 1) the azeotropic method with perchloroethylene which is rather expensive; 2) steam drying; and 3) fire drying. The waste gas from steam drying is rich in amines, and from fire drying rich in sulfur dioxide. Both carry large amounts of reducing substances. Spraying the gas in two steps brought satisfying results. In the first stage the waste gas is sprayed with a base and in the second stage with diluted sulfuric acid. In this stage agglomeration of aerosols from the drying fish meal occurred which were to a large degree responsible for the bad odors. This two-stage washing method, together with the 1:1000 diluting effect of a high chimney were sufficient to eliminate the obnoxious odors from the fish meal plant.

07531

H. O. Hettche, H. Schwarz, W. Luhr

WASTE GAS CLEANING IN THE ANIMAL PRODUCTS INDUSTRY - PART II. (Abgasreinigung in der Industrie tierischer Produkte - Teil II.) Text in German. Stadtehygiene (Uelzen/Hamburg), 15(7):155-158, July 1964.

Waste gas from the production of fish meal contains up to about 200 mg/cu m of ammonia, 15 mg/cu m of substances containing sulfur (H2S and mercaptans), 5 to 10 mg/cu m of carbonylic compounds, and sulfurous and organic acids up to 100 mg/cu m. There are also substances which are reduce by potassium permanganate, of the amount of 1000 to 1500 mg/cu m. Such waste gas could be successfully deodorized by a three- stage scrubber. In the first stage the waste gas is cooled below 30 degrees C by spraying it with water in a jet spray tower. The second tower used 2% NaOH and sodium bleach, and the third tower sprayed 0.5% H2SO4. Cooling below 30 degrees was necessary to reduce the concentration of organic (mostly oily) compounds. Results of other experiments in this series are also reported in the form of three tables.

07875

T. E. Kreichelt, D. A. Kemnitz, S. T. Cuffe

ATMOSPHERIC EMISSIONS FROM THE MANUFACTURE OF PORTLAND CEMENT. Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-17, 47p., 1967. 29 refs. GPO: 803-789-2

Information is presented on actual and potential atmospheric emissions resulting from the manufacture of cement. Raw materials, process equipment, and production processes are described, as well as the location of plants, and process trends. Emission and related operating data are presented, along with methods normally employed to limit or control emissions from the dry, semi-dry, and wet processes. The main source of emissions in the cement industry is the kiln operation. Dust generated in the dry-process kiln may vary from 1 to 25 percent expressed in terms of finished cement; from the wet process, 1 to 33 percent. Sulfur dioxide emissions from the kiln gases combine with the alkalies as condensed sulfates. In the wet process, an odor problem may arise from heating certain types of raw material such as marine shellls, marl, clay, or shale. Another important source of dust emissions in the cement industry is the dryer normally used in dry process plants. Dust can be adequately arrested in the cement industry by proper plant layout and proper selection of high-efficiency multicyclones, electrostatic precipitators, or fabric filters. Electrostatic precipitators or fiber-glass fabric filters that have been properly designed, installed, operated, and maintained will adequately collect the dust from the hot kiln gases. In many plant designs, multicyclones precede the precipitator or fabric filter. Precipitators or low-temperature fabric filters alone may be adequate on other unit operations such as handling, crushing, grinding, drying, and packaging. Dust emissions as low as 0.03 to 0.05 grains per standard cubic foot have been obtained in newly designed, well controlled plants.

07971

Kukin, Ira

CHEMICAL SUPPLEMENTS IN AIR POLLUTION CONTROL PROGRAMS. Apollo Chemical Corp., Clifton, N.J., FL-67-65, ((32))p., 1967. 12 refs. (Presented at the National Fuels and Lubricants Meeting, New York, N. Y., Sept. 13-14, 1967.)

Several classes of chemical additives for petroleum fuels and coals have been developed that reduce air pollutants from smoke stacks. These are: (1) combustion catalysts, (2) smoke-suppressants, (3) oil-ash (slag) modifiers, (4) absorptive agents, (5) SO3 neutralizing agents. The application of these products to specific air pollution reduction programs is shown by several case histories involving the following power plants: (1) 4-cycle diesel trucks, (2) 2-cycle diesel buses, (3) diesel power generating equipment, (4) gas turbine for peaking operations, (5) school heating equipment with No. 4 oil, (6) industrial plant boiler with Bunker C fuel, (7) refinery boiler burning No. 6 oil and gas, (8) marine steam plant, (9) utility power plant, (10) coal-fired utility. These specific examples cover the known types of polluting materials from fuel and coal burning power plants. A ready guide for specific utilization of the chemical treatments is summarized. It has been shown that chemical supplements are 80 to 100% effective for improving the combustion of the fuels resulting in a decrease of smoke, particulate matter, odors and aerosols as well as acidic and acrid SO3 with a resultant reduction in stack plume. Chemical supplements appear to be uneconomical generally to completely eliminate SO2 from the exhaust gases. There are indications, however, that by reducing the aerosols forming soots and particulate matter from the exit gases, the smog-forming tendencies of SO2 are reduced substantially.

08104

ON THE EFFECT OF AIR CLEANING EQUIPMENT INSTALLED IN THE CLEAN SHELTER. Text in Japanese. Air Filtering System Designing Committee, Japan. Kuki Seijo (Clean Air: J. Japan Air Cleaning Assoc., Tokyo), 5(2):1-26, July 1967

The effectiveness of air cleaning equipment, installed in a small building to be used as a shelter against air pollution in one of the most polluted areas of Japan (Yokkaichi City), is discussed. The shelter was an old building, recently rebuilt to provide airtight windows and doors. The equipment included an electric precipitator (capacity 96 cu m/minute; dust removing efficiency 90 percent) and two charcoal beds (30 kg of charcoal for circulating air and 5 kg for fresh air). Concentrations of dust and SO2 were determined for the air in the shelter and for outside air. It was found that: (1) the concentration of SO2 in the shelter was much lower than outside the shelter; (2) the bad odor of the outside air was completely absorbed by the charcoal filter; (3) the dust generated in the shelter was due chiefly to cigarette smoking (the quantity per cigarette is estimated): and (4) the quantity of fresh air in the shelter was 570 cu m/h which is not sufficient if the number of people exceeds 200 (in which case the concentration of CO2 exceeds the limit of 1500 ppm in about 2 hours). The shelter can be effectively used during periods of particularly bad atmospheric pollution, provided that such periods are not of long duration. The results were analyzed theoretically with regard to the design of air pollution shelters.

08360

Hansen, G. A.

ODOR AND FALLOUT CONTROL IN A KRAFT PULP MILL. J. Air Pollution Control Assoc., 12(9):409-414, Sept. 1962. 4 refs. (Presented at the 55th Annual Meeting of APCA, Sheraton-Chicago Hotel, Chicago, Ill., May 20-24, 1962.)

A kraft mill air pollution problem exists in two phases: The general odor-control systems currently being used in two Weyerhaeuser kraft mills are described. The systems are practical from a cost standpoint and are reasonably effective. These systems are based on collecting and destroying the malodorous compounds by burning or by chlorine oxidation in the case of digester blow and relief gases. In the recovery furnaces and evaporators, release of odors is prevented through black liquor oxidation and by carrying excess oxygen in the recovery furnace flue gas. Flyash at the Everett Kraft Mill has been reduced effectively by combining lime kiln and recovery furnace flue gases before passing them through a modified Venturi scrubber. Particulate matter discharged, as measured by sodium concentration in the flue gas at the top of the stack, has been reduced over 90%. This is confirmed by fallout samples taken in the vicinity of the mill itself. The installation of the systems described has reduced complaints to the vanishing point. ASM

08361

Hartler, Nils

RECENT EXPERIENCES IN POLYSULFIDE COOKING. TAPPI, 50(3):156-160, March 1967. 18 refs. (Presented at the 20th Alkaline Pulping Conference of the Technical Association of the Pulp and Paper Industry, Richmond, Va., Sept. 13-16, 1966.)

A changeover to polysulfide pulping in a kraft mill requires the introduction of new techniques or modifications of those presently existing. Preparation of the cooking liquor is preferably done by dissolving sulfur in white liquor from the recovery cycle. The dissolution process is considered from a theoretical as well as a practical chemical engineering viewpoint. The procedure of adding sulfur to the digester together with the wood is compared that of separate dissolution. In order to fully control the cook, a knowledge of two parameters, effective alkali and excess sulfur content, is sufficient. Some procedures for the determination of the latter are described, and preference is given for the redox method. Polysulfide does not affect the removal of lignin to any appreciable extent. It is shown that, with no extra alkali added fairly small amounts of carbohydrate polymers are dissolved in the cooking liquor. The achieved stabilization caused by oxidation is probably not as complete as in the case of reduced carbohydrates. The net effect on pulp yield is, however, very much the same as in the case of borohydride cooking. This build-up of sulfide is probably the cause of the higher odor level. The differences between the quality of polysulfide and kraft pulp are summarized, and the implications are that if the papermaker places the main emphasis on beatability and stock freeness, polysulfide cooking would be a very attractive alternative to conventional kraft cooking. If, however, tear factor is an important strength consideration, polysulfide cooking becomes less attractive. AA

08364

Landry, J. E.

BLACK LIQUOR OXIDATION PRACTICE AND DEVELOPMENT--A CRITICAL REVIEW. TAPPI, 46(12):766-772, Dec. 1963. 22 refs.

The progress in black liquor oxidation research, development, and application is summarized, along with experimental data from laboratory research and mill operations. In the kraft recovery process, oxidation of the black liquor prior to evaporation and burning leads to a considerable reduction in sulfur loss to the atmosphere and improved chemical recovery. For these reasons, research and development on oxidation processes during the last five years have proceeded rapidly and kraft mills in this country have been quick in applying the results of these investigations, despite the fact that problems still remain to be solved under some conditions of operation. (Author's abstract, modified)

08467

Vogel, H. E.

THE ANNUAL MEETING OF THE SWISS ASSOCIATION FOR FLOOD PROTECTION AND AIR HYGIENE (VGL). ((Die Jahrestagung der Schweizerischen Vereiningung fur Gewasserschutz und Lufthygiene (VGL).)) Text in German. Wasser Abwasser (Munich), 108(38):1088-1089, Sept. 1967.

A report is given in which the 'Purity of the air in the vicinity of the Shell refinery at Cressier' is reviewed. There are four plants in the vicinity of Cressier which may pollute the air: a cement factory, a refinery, a thermal paper mill, and a plant for the drying of potato flakes. In the refinery, several steps are taken to ensure air purification: the use of floating covers to prevent vaporization of volatile compounds from drying pans, siphoning off and burning of noxious vapors, preparation of odorless sulfur from H2S and mercaptans, and the use of refinery gas to limit sulfur dioxide emissions. In contrast to water pollution, the area of air pollution may entail psychological problems such as fears of sickness from breathing noxiuos odors, of impaired breathing, or even smothering.

08497

Hoffman, Heinz

EXHAUST GAS PROBLEMS WITH GASOLINE AND DIESEL ENGINES. II. DIESEL ENGINES. ((Abgasprobleme bei Otto- und Dieselmotoren. II. Dieselmotoren.)) Text in German. Erdoel Kohle (Hamburg), 20(9):644-648, Sept. 1967.

The various pollutants present in the smoke produced by diesel engines were measured and discussed. The results, illustrated in tables and graphs, show that CO emission is only 1/10 that allowed for gasoline engines and is therefore of minor importance. Aldehydes with their characteristic irritating odor are also produced in small quantities and are considered annoying, but medically unimportant. The nitrogen oxides, NO and NO2, are produced in sufficiently large quantities to cause lack of oxygen in the blood, and inflammation of the respiratory tract. The antechamber motor produces fewer nitrogen oxides than the direct injection motor. Amount of SO2 produced is negligible. 3,4-Benzopyrene is emitted in significant quantities when an engine emits a large quantity of smoke and then only if the motor is run under high pressure. As a control measure a reduction in smoke quantity is recommended. The smoke characteristics can also be greatly influenced by the design of the combustion chamber and proper maintenance of the engines.

08506

EXPLORING THE APPLICABILITY OF DIRECT-FLAME INCINERATION TO WIRE ENAMELING FUME CONTROL. Wire Prod., 42(11):1981-1988, Nov. 1968. (Presented at the Electrical Conductor Division of the Wire Association, Chicago, Ill., Oct. 23, 1968.)

To test the applicability of direct-flame incineration to control fumes emitted in the wire enameling process, a portable direct-flame incinerator was used. The effectiveness of the incineration of objectionable fumes at temperatures of 1,400, 1,200 and 1,000 + deg. F. was investigated by chemical and instrument analysis of phenolic compounds, heavy hydrocarbons and light gaseous hydrocarbons as well as by a quantitative odor measurement, using an odor panel. A description and schematic diagram of the portable incinerator unit is provided. Tabulated data include summaries of operating conditions, of the analysis and of odor panel tests. The test program showed that excellent cleanup of the exhaust from a wire-enameling oven could be achieved with direct-flame incineration. On the basis of test data analysis it was concluded that an efficiency of 90% (based on p.p.m. by weight reduction of contaminant) could be achieved at an incineration temperature of 1,350 + deg. F. with residence time of one-half second when using a nozzle-mix burner in a properly designed combustor. As a result of an engineering study to establish the most practical physical arrangement of a direct-flame incineration system that could fulfill the requirements of a typical wire enameling plant, a system was developed for a battery of enameling towers which is highly efficient and includes a waste heat recovery feature to make it more economical.

08604

Fiala, Ernst, and Zeschmann, Ernst-Georg

IRKSOMENESS OF EXHAUST GAS ODOR. ((Lastigkeit von Abgasgeruch.) Text in German. VDI (Ver. Deut. Ingr.) Z. (Duesseldorf), 109(24):1139-1141, Aug. 1967. 5 refs.

The fresh air dilution of automotive exhaust gases at which the odor was just detected by 10 subjects was used to measure the odor intensity. The engine was operated at various conditions and with air added directly toward exhaust valve. The subjects first breated fresh air, to which untreated exhaust was added until the odor was detected. The amounts of carbon monoxide and hydrocarbons were measured at this point, for each of the different operating conditions. The same procedure was repeated with the addition of air toward the exhust valve. Graphically presented data show that while the emission of CO and hydrocarbons considerably diminished with the addition of air, the odor intensity of the gas increased significantly.

08663

Starkman, Ernest S.

CHEMICAL POLLUTION FROM TRANSPORTATION VEHICLES. Preprint, California Univ., Berkeley, Coll. of Engineering, 16p., 1967. (Presented at the 134th Annual Meeting, American Assoc. for the Advancement of Science, Interdisciplinary Symposia on Man and Transportation, New York, N. Y., Dec. 30, 1967.)

The gasoline engine will probably be the principal power plant for passenger cars for at least the next decade. Chemical pollutants discharged by the gasoline engine are now under partial control. Carbon monoxide and unburned hydrocarbons from 1968 model cars are approximately 30 percent of that from prior production. Further demonstrated reductions can reduce this number to less than 10 percent in a decade. Additionally, in ten years, oxides of nitrogen can be reduced to about 20 percent of existing levels. Theory shows that carbon monoxide, unburned hydrocarbons and oxides of nitrogen ultimately can be completely removed from gasoline engine exhaust. Present designs of gas turbines for aircraft and for future projected application to ground vehicles yield pollutant (except for smoke) at levels below that of the gasoline engine of a decade hence. It has also been shown possible to eliminate smoke as well as odor from the gas turbine. Thus with proper effort, it is feasible to effectively reduce pollution of the atmosphere due to transportation to an acceptable level, even if electrically or alternatively powered vehicles cannot be developed for a decade. (Authors summary, modified)

08946

Mellor, Joseph F., Jr.

A MULTIPURPOSE FLARE STACK FOR CONTROL OF CHEMICAL PROCESS WASTES. J. Air Pollution Control Assoc., 10(6):465-467, Dec. 1960. 4 refs. (Presented at the 53rd Annual Meeting Air Pollution Control Assoc., Cincinnati, Ohio, May 22-26, 1960.)

A flare stack was constructed to dispose of hydrogen sulfide gas in lieu of scrubbing or recovery. Investigation was made to determine the feasibility of using this flare stack to incinerate the volatiles entrained by the vacuum system. Discharge of the odorous vapors at ground level was discontinued and an improved olfactory effect was immediately apparent. By diverting contaminated process waters into a collection tank they can be pumped into the hot well at a slow rate and, given sufficient residence time, the volatiles can be flashed off and vented to the flare. The burning flame was relatively smokeless. The cost of propane used on the flare was 3.22 dollars per day. The system described has been successfully applied to five 500-gal glass lined Pfaudler reactors.

09407

Robinette, Gary

PLANTS AS AIR CONDITIONERS. Horticulture, 46(3):26-29, March 1968.

Plants are known to emit oxygen, consume carbon dioxide, as well as 'eat' dust. They remove air-borne impurities by dilution, precipitation or filtration, narcosis, air washing, oxidation, and reodorization or masking. Thus, plants can be considered among the most effective air conditioners in existence. The author mentions potentials utilization of these properties, for example, planting a half-mile greenbelt on either side of highways or planting fragrant plants near sources of disagreeable odors.

09508

Harding, C. I.

SOURCE REDUCTION IN THE PULPING INDUSTRY. Proc. Fifth Ann. Vanderbilt Unit. Sanitary and Water Resources Engineering Conf., p. 192-204, June 2-3, 1966. 6 refs.

It is possible at this time to drastically reduce the normal odorous emissions from kraft mills. Few mills, if any, have utlized all of the possible control steps, many of which are discussed. Most new mills are being designed with reduction of atmospheric emissions as a primary aim. Recent and current research efforts are pointing the way to better control of mill emissions by reducing the quantity of pollutants formed during the pulping and recovery processes. (Author's summary, modified)

09608

Stahman, Ralph C., and George D. Kittredge, and Karl J. Springer

SMOKE AND ODOR CONTROL FOR DIESEL-POWERED TRUCKS AND BUSES. Preprint, Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control and Southwest Research Inst., San Antonio, Tex., Dept. of Automotive Research, 85p., 1968. 3 refs. (Presented at the Society of Automotive Engineers Mid-Year Meeting, Detroit, Mich., May 1968.)

A test facility was developed in which full-scale trucks and buses were operated on a chassis dynamometer through operating modes that yielded maximum exhaust smoke and odor. A system of exhaust dilution was employed to provide realistic odor concentrations to a panel of judges who rated the intensity and quality of the exhaust in terms of a set of chemical standards. Smoke levels were measured with PHS-designed full-flow optical smokemeter. After an initial baseline evaluation of groups of buses and trucks with standard engines, various control techniques including manifold fumigation, exhaust dilution, engine derating, Jacobs engine brake, smoke suppressant fuel additive, catalytic mufflers, and two-cycle versus four-cycle engines were evaluated to determine their effectiveness in reducing smoke and/or odor. Chemical analyses of the exhaust were made for the purpose of correlting the smoke and odor reductions with changes in exhaust compositon. Extended mileage tests in commercial fleet service were initiated on those control techniques that appeared most promising. (Authors' abstract, modified)

09655

Major, William D.

VARIATIONS IN PULPING PRACTICES WHICH MAY EFFECT EMISSIONS. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and University of Florida. DeLand, Fla., E. O. Painter Printing Co., ((1966)), p. 265-281. 8 refs.

Emissions from a kraft mill can be divided into two categories, gaseous and particulate. Malodorous emissions are subject to far less control and precision of analysis than particulate emissions. The magnitude of loss is more sensitive to operating variables, the chemistry is more complicated and the sources are more numerous. This discussion is concerned with the effect of operating variables on gaseous sulfur losses. Evidence is given which indicates that the wood species has a definite effect on the odor produced during kraft pulping. Cooking variables include: sulfidity of the white liquor, cooking time and cooking temperature. More recent cooking variables are: continuous vs. batch digestion, and the use of black liquor dilution in the digester as a means of controlling the liquor -to-wood ratio. Multiple-effect evaporators are the second largest source of gaseous sulfur losses in the process. The high vacuums set up by condensers result in the release of low vapor pressure sulfur compounds. Operating variables in direct contact evaporation are: black liquor pH, sodium sulfide concentration, and per cent CO2 in the flue gas. Dust losses from the recovery furnace are controlled with either a venturi scrubber or an electrostatic precipitator. Operating variables which influence the efficiencies of these two units are overloading, and the temperature of the flue gas. The key to the effect of operating variables on emissions from a kraft pulp mill is to recognize the degree to which the various steps in the kraft process are interrelated, especially in the case of gaseous sulfur losses.

09656

Lindberg, Siguard

REDUCTION OF AIR AND WATER POLLUTANTS AT THE SKOGHALL MILLS. In: Proceedings of the International Conference on Atmospher- ic Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Pub- lic Health Service, National Council for Stream Improvement, and University of Florida. DeLand, Fla., E. O. Painter Printing Co., ((1966)), p. 335-346.

Over the years several measures have been taken to destroy or to reduce air and water pollutants from the sulfate mill in Skoghall, Sweden. To identify the emission points, the actual departments at the sulfate mill are described. The primary sources of odor at the mill, and measures taken to dispose of them are shown in a table. A detailed discussion, with the aid of illustrations, describes fully the measures taken to control the odors at each point. It is concluded that the measures to improve the factory surroundings with regard to malodorous pollutants had the intended result, and at a reasonable cost.

09661

Lindberg, Sigvard

COMBUSTION OF MALODOROUS GASES FROM ALKALINE PULP COOKING. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and University of Florida. DeLand, Fla., E. O. Painter Printing Co., ((1966)), p. 370-372.

This paper describes an invention to get rid of malodorous air and water pollutants by combustion of gases from the cooking in a continuous digester of alkaline pulp, especially sulfate pulp. The aim of this invention is to destroy both air and water pollutants in one single operation. The application to continuous cooking is demonstrated with a flow diagram.

09729

STABILIZED CHLORINE DIOXIDE FOR ODOR CONTROL. Public works, 99 (4):166, April 1968.

When a blower in the wastewater treatment plant in Phillipsburg, New Jersey, failed during the summer, the superintendent arranged for addition of stabilized aqueous chlorine dioxide. This com- mercially available product was added to the aeration tank effluent by a simple petcock arrangement on the drum, and a drip feed. Odors began to diminish rapidly and were under control by the next day. Addition of the chlorine dioxide continued for the next 41 days at the rate of 1.3 mg./1. This product can be activated by the reduction of pH, by the presence of free residual chlorine in the water, or by the addition of small amounts of sodium hypochlorite.

09733

Shah, I. S. and Louis Mason

NEW TWO-STAGE EVAPORATOR-SCRUBBER SYSTEM FOR EFFICIENT RECOVERY OF HEAT, FUME, AND DUST FROM RECOVERY BOILERS. TAPPI, 50(10):27A- Conference of the Technical Association of the Pulp and Paper Industry, Boston, Mass., Oct. 31-Nov. 3, 1966.)

In recent years, Federal, State, and local authoritities have enacted laws and regulations to reduce the quantities of air pol- lutants. This has created a necessity for tne pulp and paper in- dustry to improve overall collection and odor removal efficiencies. Presently available equipment, because of some inherent design problems is not able to meet these new requirements. This has led to the development of a two-stage evaporator-scrubber system, which offers almost all the advantages and eliminates most of the dis- avantages of existing systems. Secondary scrubbing systems have been developed to enable lpulp mills to improve the overall dust collection and odor removal efficiencies of their existing systems. This paper describes in detail the history of development and operating characteristics of the two-stage evaporator-scrubber sys- tem and of the secondary scrubbing systems. A new improved S-F type venturi scrubber, as applied successfully in the pulp and paper industry, is also described. (Authors' abstract)

09784

Danielson, John A. (comp. and ed.)

AIR POLLUTION ENGINEERING MANUAL. (AIR POLLUTION CONTROL DISTRICT, COUNTY OF LOS ANGELES.) Public Health Service, Cincinnati, National Center for Air Pollution Control, PHS-Pub-999-AP-40, 999-AP-40, 892p., 1967. ((314)) refs. GPO: 806-614-30

The control of air pollution at individual sources peculiar to the Los Angeles area is considered. The practical engineering problems of design and operation for many sources of air pollution are emphasized. There are 11 chapters, each by different authors, and 4 appendixes. The chapter titles are: (1) Introduction; (2) Contaminants; (3) Design of Local Exhaust Systems; (4) Air Pollution Control Equipment for Particulate Matter; (5) Control Equipment for Gases and Vapors; (6) Metallurgical Equipment; (7) Control Equipment; (8) Incineration; (9) Combustion Equipment; (10) Petroleum Equipment; and (11) Chemical Processing Equipment. The introduction discusses the Los Angeles Basin, rules and regulations in Los Angeles County, and the use of the manual. The appendixes' titles are: (A) Rules and Regulations; (B) Odor-Testing Techniques; (C) Hypothetical Available Heats from Natural Gas; and (D) Miscellaneous Data.

09791

Dey, Howard F.

AFTERBURNERS. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 171-187, 1967. GPO: 806-614-30

Specifications and design parameters, the operation, applications, and efficiency of direct-fired and catalytic afterburners are discussed. Examples showing calculations of some factors considered in the design of a direct-fired afterburner to be installed in a meat smokehouse and a catalytic afterburner to be installed to eliminate odor from a direct-fired process oven are illustrated. Results of stack emissions from several direct-fired and catalytic afterburners are also outlined. The process equipment and the afterburner used in each case are briefly described. A survey of installation cost of direct-fired and catalytic afterburners reveals a general range from 5 to 10 dollars per scfm contaminated gas.

09794

Walsh, Robert R. and Robert C. Murray

VAPOR CONDENSERS. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, . 201-210, 1967. GPO: 806-614-30

In specific instances, control of vapor-type discharges can best be accomplished by condensation. Other applications require a condenser to be an integral part of other air pollution control equipment. In these cases, a condenser reduces the load on a more expensive control device or removes vapor components that may affect the operation or cause corrosion of the main control element. Probably their most common application is as auxiliary to afterburners, absorbers, baghouses, and other control devices. Air Pollution Control condensers operate through removal of heat from the vapor. Condensers differ principally in the means of cooling. In surface condensers, the coolant does not contact the vapor or condensate. In contact condensers, coolant, vapor, and condensate are intimately mixed. Several types of condensers and several combinations of condensers with other types of control devices are illustrated. An example calculating the quantity of cooling water required for a contact condenser used to condense malodorous vapors from a dry rendering cooker is illustrated. The design of a condenser for condensation of vapor in the presence of a noncondensable gas is discussed with the aid of several mathematical equations. Eighteen pertinent facts that will assist in handling condenser problems, and processes or equipment whose condensers have been used successfully either separately or with additional control equipment are listed.

09813

Vincent, Edwin J. and John L. McGinnity

DRIER, In: Air Pollution Engineering Manual. (Air Pol- lution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub- 999-AP-40, p. 367-372, 1967. GPO: 806-614-30

Some general characteristics of driers and some details of the rotary, flash, and spray driers are considered. Air Pollution problems, hooding and ventilation requirements, and control equipment are included. Air contaminants that may be emitted from driers are dust, vapors, smoke, and odor. Dust can be a problem in any drier in which the material is agitated or stirred during the drying process. Drier types that can be prolific dust producers are direct-fired rotary driers, flash driers and spray driers. Types that produce less dust are indirect-fired rotary driers, pan driers, any cylinder driers. Other types that may emit no dust include tray driers, sheeting driers, and driers of products such as lumber, bricks, ceramic ware and so forth. When an organic liquid is to be removed from a material, the emissions may include vapor, mist, odor, and smoke. In general, three types of control are used on driers: dust collectors, condensers, and afterburners. All types of dust collectors are used, depending upon the amount and particle size of the dust emitted. The types of dust collectors most commonly used on driers are cyclones, scrubbers, and baghouses. Condensers are used when a material wet with an organic solvent is dried. Vacuum driers are well suited to recov- ery of solvent vapors. Afterburners are used to control smoke, combustible particulate matter, vapors, and odors.

09815

D'Imperio, Joseph

RUBBER-COMPOUNDING EQUIPMENT. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS- Pub-999-AP-40, p. 375-378, 1967. GPO: 806-614-30

The two most commonly employed pieces of equipment for blending rubber and additives are rubbermills and Banbury mixes. Types of additives that are compounded into the rubber may be classified as vulcanizing agents, vulcanizing accelerators, accelerator activators, retorders, antioxidants, pigments plasticizes and softeners, and fillers. Examples of each type additive are listed. Sources of air pollution from the mills are (1) finely ground dust introduced as additives, (2) fumes generated by mechanical working of the batch by the mill rollers, (3) oil mist from liquid additives, and (4) odor. A major source of air pollution from rubber mills occurs when the finely divided dust are introduced into the batch. Introduction of ingredients into a Banbury mixer is effected through the feed hopper. It is at this point, during charging, that air contaminants may center the atmosphere. Emissions are similar to those from the mills. Generally, rubber mills are provided with hoods. Sufficient volume should be exhausted to give an indraft velocity of 100 fpm through the open face of the enclosure. The minimum required exhaust volume for Banbury mixers is equal to 200 cfm per square foot of mixer charg- ing opening. Exhaust provisions supplied with two Banbury mixers are shown schematically. In general emissions are in a finely divided form and smaller than 15 micron. The most common control device employed is the baghouse. A well designed baghouse can be operated with 98 to 99 per cent efficiency. In some cases scrub- also proved satisfactory and advantageous in scrubbing out some oil bing out some oil vapors and oil mist that may be present in some

09819

Chatfield, Harry E.

PIPE-COATING EQUIPMENT. In: Air Pollution Engineering Manual. (Air Pollution Control District, Coutny of Los Aneles.) John A. Danielson ncomp. and ed.). Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 390-393, 1967. GPO: 806-614-30

Asphalt and coal for enamel is applied to pipes on order to exclude corrosive elements from contacting the metals. The three usual methods of applying asphalt or coal coatings are dipping, wrapping and spinning. Each application method is described. The largest source of air pollution from asphalt or coal tar operations is the dense white emissions caused by vaporation and subsequent condensation of volatile components in the enamel. This cloud is composed of minute oil droplet. These emissions are objectionable on three counts that include opacity, odor, and toxicity--those from coal tar being the more objectionable. Because of the nature of all three of the methods used to apply asphalt and coal tar enamels to pipe, collection of the contaminants is difficult. One solution is to install a stationary hood at the end of the pipe where the lance is inserted. A portable fan or blower is used at the other end to blow air through the pipe, conveying the emissions to the hood at the other end. Another solution of the fume collection problem is to house all the equipment and vent the building to the air pollution control system selected. This method may not be necessary for an isolated spinner or wrapper, but a dipping process or a process using several coating operations, it is more satisfactory than using local exhaust systems. Three basic types of devices can be considered for control of the emissions from asphalt and coal tar application. These are (1) scrubbers, (2) incinerators (afterburner), and (3) electrical precipitators. Water scrubbers have been used most frequently. Incineration is the most positive method of complete control, but economic factors practically eliminate its application. The high initial cost of electrical precipitators as compared with that of scrubber systems, has also made them unattractive.

09827

Talens, Paul G.

PATHOLOGICAL-WASTE INCINERATORS. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 460-471, 1967. GPO: 806-614-30

Multiple-chamber incinerator design considerations for burning pathological-waste are discussed. Crematory furnaces are also discussed since they have design standards similar to those of pathological-waste incinerators. The cremation of human remains differs from other pathological incineration only in that the body is usually contained in a wooden casket. The casket must be considered when designing these units. Pathological-waste incinerators can produce emissions of fly ash, smoke, gases, and odors that would be highly objectionable. The prevention of air contaminant emissions by good equipment design is the best air pollution control procedure to follow. As with other incinerator design calculations, those for pathological-waste incinerators also fall into three general categories: (1) Combustion calculations, (2) flow calculations and (3) dimensional calculation. The factors to be used in these calculations for pathological incinerator design are listed. Typical calculations involved in the design of an incinerator to dispose of 100 pounds of dog bodies per hour are illustrated.

09830

Netzley, Arthur B.

WIRE RECLAMATION. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 495-503, 1967. GPO: 806-614-30

Scrap copper wire, with a diameter in the range 14 gage to one inch, which has combustible insulation is reclaimed by burning off the insulation in an incinerator. A great variety of materials composes the combustible insulation: Rubber, paper, cotton, silk, and plastics such as polyethylene and polyvinyl chloride. Moreover, the wire itself may have a baked-on coating of plastics, paint, or varnish. As received for burning, the total combustible content of the insulated wire may vary widely from several percent to over 50 percent by weight. Most commercial wire contains from 20 to 35 percent insulation. Burning in the open is accompanied by copious quantities of dense smoke, disagreeable odors, inorganic materials, and oxygenated hydrocarbons. Burning in single-chamber incinerators produces somewhat less smoke, odors, and other air contaminants than open burning does, since combustion air can be regulated. The only practical industrial equipment available today for controlling emissions from single-chamber insulation-burning incinerators is an afterburner or secondary combustion chamber. The composition of stack gases from equipment with and without afterburners is presented. Design methods, materials of construction, and operating procedures are discussed and illustrated.

09836

Murray, Robert C.

STORAGE VESSELS. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Ageles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 606-629, 1967. GPO: 806-614-30

Various types of storage vessels for liquid and gaseous petroleum products are described and discussed in light of vapor emission problems (evaporation and breathing), pressure (advantages and tank design limitations), solar heating, and design of vessels and vapor seals. The types of vessels considered are: pressure; fixed, floating, and vapor seal roof; open top; reservoirs, pits, and ponds; and floating microsphere foam roof tanks. Specific emissions are vapors, mists, and odors. These are due to evaporation from wet vessel walls during draining operations, entrainment of material by winds, evaporation from the bulk caused by solar heating, and tank breathing due to diurnal temperature changes. Quantitative methods for determining the extent of these emissions are presented and illustrated. Emission control devices and methods included are vapor seals for floating-roof vessels, vent scrubbers, floating plastic blankets, vapor recovery systems, vapor conservation vessels, and vapor balance systems where various tank vents are connected. Graphs of installed cost for various types and sizes of vessels are presented.

09839

Kinsey, Robert H.

OIL-WATER EFFLUENT SYSTEMS. In: Air Pollution Control Dis- trict, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Cen- ter for Air Pollution Control, PHS-Pub-999-AP-40, p. 652-659 1967. GPO: 806-614-30

Oil-water effluent systems found in the petroleum industry collect and separate wastes recover valuable oils, and remove undesirable contaminants before discharge of the water to ocean, rivers, or channels. The type of liquid wastes may be classified as waste water with: Oil present as free oil, emulsified oil, or as oil coating on suspended matter; and chemicals include acids, alkalies, phenols, sulfur compounds, clay, and others. The oil-water separator design must provide for efficient inlet construction, sediment collection mechanisms, and oil skimmers. Clarification of final-effluent water streams is accomplished by filtration, chemical flocculation, and biological treatment. The most objectionable contaminants emitted from liquid waste streams are hydrocarbons, sulfur compounds, and other malodorous materials. The method presented may be used to estimate the hydrocarbon loss from oil-water separators. The most effective means of control of hydrocarbon emissions from oil-water separators has been the covering of forebays or primary separator sections with fixed roofs or floating roofs. Isolation of certain odor-and chemical-bearing liquid wastes at their source for treatment before discharge of the water to the refinery waste-water gathering system is an effective and economical means of minimizing odor and chemicals problems. Principal streams that are treated separately are oil-in-water emulsions, sulfur-bearing waters, acid sludge, and spent caustic wastes. Gravity-type oil-water separators are ineffective in breaking the oil-in-water emulsions. Meth ods of separation include direct application of heat, distillation, centrifuging, filtration, use of an electric field coagulating chemicals, air flotation systems, and biological treatment. Sulfide -and mercaptan bearing water may be steam stripped, or the sulfides may be oxidized to form acceptable thiosulfates, will produce H. S. Acid sludge is dumped, burned, or processed to recover acid or to produce byproduct. Spent caustic wastes are generally dumped, or can be used in the neutralization of acid wastes.

09840

Kinsey, R. H.

PUMPS. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 659-665, 1967. GPO: 836-614-30

Pumps are used in every phase of the petroleum industry and are available in wide variety of models, sizes, capacities and materials used for construction. All the common machinable metals and alloys, as well as plastics, rubber, and ceramics, are used. Pumps may be classified under two general headings, positive displacement and centrifugal. Positive-displacement pumps have as their principle of operation the displacement of the liquid from the pump case by reciprocating action of a piston or diaphragm, or rotating action of a gear, cam, vane, or screw. Centrifugal pumps operated by the principle of converting velocity pressure generated by centrifugal force to static pressure. Velocity is imparted to the fluid by an impeller that is rotated at high speeds. The fluid enters at the center of the impeller that is rotated at high speeds. The fluid enters of the impeller and is discharged from its periphery. Power for driving the various types of pumps is usually derived from electric motors, internal combustion engines, or steam drives. Any leak in the pumping equipment causes emission of hydrocarbon vapors and malodorous sulfur compounds. Several means have been devised for sealing the annular clearance between pump shafts and fluid casings to retard leakage. For most refinery applications, packed seals and mechanical seals are widely used. Typical packed seal generally consist of a stuffing box filled with sealing material that encases the moving shaft. Lubrication of the contact surfaces of the packing and shaft is effected by a controlled amount of product leakage to the atmosphere. The second commonly used means of sealing is the mechanical seal. This type of seal can be used only in pump that have a rotary shaft motion. A simple mechanical seal consists of two rings with wearing surfaces at right angles to the shaft. One ring is stationary while the other is attached to the shaft and rotates with it. A spring and the action of fluid pressure keep the two faces in contact. Lubrication of the wearing faces is effected by a thin film of the material being pumped. The wearing faces are precisely finished to ensure perfectly flat surfaces. For cases not feasible to control with mechanical seals, specialized types of pumps, such as canned, diaphragm, or electromagnetic, are required. A pressure-seal-type application can reduce packing gland leakage. A liquid, less volatile or gangerous than the product being pumped, is introduced between two sets of packing at a higher pressure than the product. Volatile vapors that leak past a main seal may be vented to vapor recovery by using dual 09840 Kinsey, R. H.

09842

Murray, Robert C.

COOLING TOWERS. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 672-675, 1967. GPO: 806-614030

Cooling towers are major items of heat-transfer equipment in the petroleum and petrochemical industries. They are designed to cool, by air, the water used to cool industrial processes.

Cooling of the water by air involves evaporation of a portion of the water into the air so that the remaining water is cooled by furnishing heat for this evaporation process. This cooled water is used, in turn, in heat-exchange equipment to cool other liquids and gases. The tower is packed with an open checker work of wood or metal. Hot water splashes down over the packing into a pool at the bottom. Air, by either natural, forced, or induced draft, contacts the water counter currently. Performance of the tower is at a maximum at water rates of 2 to 3 gallons per minute per square foot of ground area. General aspects of tower design are discussed. Cooling towers used in conjunction with equipment processing hydrocarbons and their derivatives are potential sources of air pollution because of possible contamination of water. A survey of the oil refineries operating in Los Angeles County indicated hydrocarbon concentrations of approximately 20 percent in the cooling water of the cooling towers. Individually the emissions varied from 4 to 1,500 pounds per cooling tower per day. The amount of hydrocarbon present in the water depends upon the state of maintenance of the process equipment, particularly the heat- exchange equipment, condensers, and coolers through which the water is circulated. The control of hydrocarbon discharges or of release of odoriferous compounds at the cooling tower is not practical. Instead, the control must be at the point where the contaminant enters the cooling water. Hence, systems of detection of contamination in water, proper maintenance, speedy repair of leakage from process equipment and piping, and good housekeeping programs in general are necessary to minimize the air pollution occurring at the cooling tower. Greater use of fin-fan coolers can also control the emissions indirectly by reducing or eliminating the volume of cooling water to be aerated in a cooling tower.

09849

Murray, Robert C. and Edwin J. Vincent

SOAPS AND SYNTHETIC DETERGENTS. In: Air Pollution Engineer- ing Manual. (Air Pollution Ontrol District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 716-720, 1967. GPO: 806-614-30

Soaps consist principally of sodium or potassium salts of fatty acids containing 12 to 18 carbon atoms. The soaps are made by reacting sodium or potassium hydroxide with fats or oils (saponification). They can also be prepared by neutralizing fatty acids with sodium or potassium hydroxide or sodium carbonate. Raw materials for soap production include tallow, grease, and coconut oil. These are hydrolyzed to obtain fatty acids and glycerol by three common methods: Twitchell, batch autoclave, and continuous high-pressure processes. Manufacture of soap is accomplished by the kettle or full-boil batch process, the Sharples continuous process, or the semi-boil process. Raw soap contains approximately 30 percent moisture and must be dried in hot-air driers, spray driers, or steam-heated tubes. The surface-active agents most commonly known as detergents are sulfated fatty alcohols, alkyl-aryl sulfonates, miscellaneous sulfates and sulfonates, cationic agents, and nonionic agents. The principal air pollution problem in the preparation of soap is odors. Blending, mixing, and packaging the finished soap can cause local dust problems. The air pollution problems encountered in preparing the base stocks are similar to those associated with a petroleum refinery. Relief valves, storage vessels, and pump seals can allow volatile hydrocarbons to escape to the atmosphere. Odors can be most successfull controlled by incineration. The most economical method of incineration consists of venting the noncondensable effluent into the firebox of a continuously operating boiler. Absorption of odors in scrubbing liquids has been tried with varying success. Spray driers are usually controllable by scrubbers. A high-efficiency scrubber, such as a venturi scrubber, is required to ensure the collection of the very fine particles. For detergents relief valves can be vented to a smokeless flare. Atmospheric vents on condensers and accumulators can be controlled by connecting the vent to a vapor recovery system.

09852

Polglase, W. L., H. F. Dey, and Robert T. Walsh

FOOD-PROCESSING EQUIPMENT. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-AP-40, p. 746-760, 1967. GPO: 806-614-30

Food processing includes operations such as slaughtering, smoking, cooking, baking, frying, boiling, dehydrating, hydrogenating, fermenting, distilling, curing, ripening, roasting, broiling, barbecuing, canning, freezing, enriching, and packaging. Some produce large volumes of air contaminants, such as odors and particulates. Pollution problems and control equipment are discussed for the following operations: coffee processing, food smoking, deep fat frying, livestock slaughtering, and fats rendering.

09854

Walsh, Robert T. and Paul G. Talens

REDUCTION OF INEDIBLE ANIMAL MATTER. In: Air Pollution Eng- ineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS-Pub-999-TP-40, p. 770-784, 1967. GPO: 806-614-30

The principal products of reduction processes are proteinaceous meals and tallow. Raw materials and process exhaust gases are highly malodorous and capable of eliciting nuisance complaints in surrounding areas. Rendering is a specific, heated reduction process wherein fat-containing materials are reduced to tallow and proteinaceous meal. Blood drying, feather cooking, and grease reclaiming are other reduction operations usually performed as companion processes in rendering plants. The most widely used reduction process is dry rendering, wherein materials containing tallow are heated indirectly, usually in a stream-jacketed vessel. In the wet process, animal matter is cooked in a closed vessel with live steam. When animal matter is subjected to heat, the cell structure breaks down liberating volatile gases and vapors. Further heating causes some chemical decomposition, and the resultant products are often highly odorous. Emission control methods include condensation of vapors, flame incineration of noncondensable odors, and adsorption of odorous exhaust gases on charcoal.

09857

D'Imperio, Joseph

OIL AND SOLVENT RE-REFINING. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp. and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS- Pub-999-AP-40, p. 799-801, 1967. GPO: 806-614-30

Used lubricants, hydraulic fluids, and solvents are purified to produce usable products by re-refining techniques. Because the profit margin is small there is very little effort or money spent on pollution control in re-refining plants. Odors and hydrocarbon vapors are frequently released without control. A simple control technique is to enclose all emission sources and incinerate the exhaust gasses in boiler fireboxes.

09922

Burnhouse, W. A.

HYDROGEN SULFIDE AND MERCAPTANS AS AIR POLLUTANTS. American Petroleum Institute, Detroit, Mich., Committee for Air and Water Conservation, ((16))p., 1966. 8 refs. (Presented at the American Petroleum Institute, American Institute of Chemical Engineers National Meeting, Detroit, Mich., Dec. 8, 1966.)

The emissions of hydrogen sulfide and mercaptans from petroleum operations and methods for control are given a general discussion. The specific sources of both compounds in refining operations are discussed. The control processes used for hydrogen sulfide include; scrubbing processes, heat regenerative methods, and absorption with various solutions. Several of these methods currently being used are discussed. There are many processes for removing mercaptans from petroleum products for which a very brief discussion is given. The recovery of sulfur as a control process is described. The cost of sulfur control to the petroleum industry is discussed.

09933

Arhippainen, Bengt, and E. Norman Westerberg

KRAFT ODOR CONTROL—ITS EFFECT ON MILL OPERATING PARAMETERS AND COSTS. Pulp Paper Mag. Can. (Gardenvale), 69(8):65-70, April 19, 1968. 9 refs.

Existing knowledge on kraft odor control is reviewed from a Scandinavian point of view. The ways a kraft odor control system may affect the mill environment and mill processing are briefly discussed. Little is known about the effect of the odor upon people, their psychology, and their attitudes. Furthermore, the performance of the recovery unit and the liquor oxidation system, if direct contact (DC) evaporation is used, are critical to the manintenance of low odor levels most of the time. The recovery boiler system with no DC evaporator, commonly used in Scandinavia, is discussed in some detail. Operating costs for this system are compared with those for a system with a DC evaporator, both with and without additional odor control equipment. For typical Finnish cost conditions, the system without the DC evaporator is slightly favored. Thus, with respect to odor control and costing, the recovery boiler system without DC evaporator may prove to be very competitive in many North American locations.

10005

Turk, Amos

MEASURING AND CONTROLLING ODORS. Heating, Piping, Air Condi- tioning, 40(1):207-210, Jan. 1968. 12 refs.

Odor problems arise when an affected group of people complains about a smell and demands that it be corrected. An odor can be characterized by its intensity, its quality, its absolute threshold and its affective tone pleasant/unpleasant dimension. It is important to relate any program of sensory odor measurement to realistic analytical objectives. Control may be achieved by use of increased dispersal (stack or ventilation), activated carbon system scrubbers, and masking or counteracting agents. The state of the a in these areas of measurement and control is reviewed.

10009

Fife, James A.

CONTROLLED COMBUSTION FOR SOLID WASTES DISPOSAL. Heating, Piping, Air Conditioning, 40(3):140-147, March 1968.

The basic design and operating characteristics of several types of large batch and continuous solid waste incinarators are discussed. Methods of particulate and odor emission control are considered wit emphasis on the effects of firing and handling methods on emission rate. Economics of incinerator operation are presented. Water-wal steam producing incinarators are compared with refractory incinerators.

10277

Blosser, R. O. and H. B. H. Cooper, Jr.

TRENDS IN ATMOSPHERIC PARTICULATE MATTER REDUCTION IN THE KRAFT INDUSTRY. TAPPI, 51(5):73A-77A, May 1968. 6 refs.

A survey of secondary wet scrubbing practices showed that relatively low-pressure-drop devices may produce a 50-80% reduction in particulate emission from precipitator streams. The per cent reduction is somewhat less when these devices are employed downsteam of venturi recovery units. Removal efficiency was observed to be independent of the type of scrubber used at the particulate concentrations in gas streams following precipitators. Final effluent quality was related directly to scrubber inlet particulate concentration. Effective scrubbing has been shown to reduce particulate fallout in the area adjacent to mills. Scrubbing may reduce particulate emissions to the atmosphere, but may also reduce the height of plume rise, hence dispersion is reduced and an odor problem may be accentuated. The principal benefits of secondary scrubbing have been upgrading of effluent quality and the assurance of an effluent of reasonably uniform quality. (Authors' summary)

10588

Petczynski, R. and R. Glowiak

METHODS OF DEODORIZATION OF WASTE GASES. ((Metody dezodoryzacji gazow odlotowych.)) Text in Polish. Gaz, Woda Tech. Sanit. (Warzaw), 42(5):157-160, May 1968. 27 refs.

Known methods for deodorizing waste gases are reviewed: deodorization by adsorption, absorption, oxidation, chemical means, and by treatment with substances which either mask or counteract odors. Technologically, the problem of removing odors differs from basic industrial adsorption processes in that no recovery of the adsorbed substances is intended since their concentration in ambient air is too small. Activated charcoal is the most commonly used adsorbent, with coconut shells furnishing the best quality of charcoal. Most noxious vapors are compounds with heavy specific gravity so that they are easily adsorbed by thin charcoal layers. The relative adsorptions of coconut charcoal for 26 odors are tabulated. Some other deodorants used are molecular sieves made from sodium or calcium aluminosilicon and zirconium sulfate, silica gel impregnated with a solution of (CH3C00) 2 Pb, CH3C00H and BAC12 or ozone ethanolamine. Deodorization absorption is often used in scrubbers.

10994

Owens, V. P.

TRENDS IN ODOR ABATEMENT FROM KRAFT MILL RECOVERY UNITS. Paper Trade J., 152(33):52-54, Aug. 12, 1968.

The chemical recovery process used in the alkaline pulping industry produces two types of pollutants - particulate matter and malodorous compounds. Wet scrubbing of the particulate matter emitted from the lime kiln stack and collection of particulate matter from the recovery unit stack by electrostatic precipitators in better than 99% collection efficiency. The control of the malodorous compounds has been more difficult. Recovery units designed without flue gas direct-contact evaporation of black liquor are now available, and when properly operated will efficiently complete combustion so that the quantities of sulfur compounds delivered to the stack will be below the minimum detectable limits at ground level. Mills having recovery units with flue gas direct-contact evaporators and efficient oxidation systems have reduced odors as much as 98% as compared with the same unit burning nonoxidized liquors.

11008

Shah, I. S.

AIR POLLUTION. PULP PLANT POLLUTION CONTROL. Chem. Eng. Progr. 64(9):66-77, Sept. 1968.

In Kraft process, chemicals in the form of solids, mists, odorous and nonodorous gases are being emitted to the atmosphere. The source of emission, the theoretical explanation for the emissions, and the various processes and equipment used to reduce the chemical and heat losses are discussed in detail.

11009

Shah, I. S. and Wayne D. Stephenson

WEAK BLACK LIQUOR OXIDATION SYSTEM: ITS OPERATION AND PERFORMANCE. TAPPI, 51(9):87A-94A, Sept. 1968.

After a thorough analysis of the advantages of weak and strong black liquor oxidation and after an evaluation of weak black liquor oxidation in a pilot plant (capable of handling 100 gal/min of liquor equivalent to 50 tons/day of pulp production), a full-scale weal black liquor oxidation system was installed. The system is designed to handle 400 gal/min of weak black liquor at 16-17° solids concentration and 4.0-6.0 g/liter of sodium sulfide content. The wood furnish is a mixture of pine and hardwood, with pine content varying to a maximum of 60%. The commercial system has successfully operated since startup and provides essentially 100% oxidation efficiency, even with variations in liquor flow and sodium sulfide content from 300 to 475 gal/min and 2.3 to 6.6 g/liter, respectively. The total operating power, including fan, pump, and foam breakers is less than 100 hp. The extensive and stable foam that is formed during oxidation is efficiently handled and causes no operating problems. As a result of the oxidation of weak black liquor, the sulfidities of green and white liquors are raised from 18.2 to 27.1% and 22.6 to 27.9%, respectively. The total lime requirement is reduced by 0.085 lb of lime per gal/min of green liquor, a 15.4% reduction. The amount of hydrogen sulfide leaving the recovery furnace stack is reduced by 98.5%. The biochemical oxygen demand of the multiple effect evaporator condensate is reduced by 27% and the pH raised from 6.5 to 9.0, thus making the 175 gal/min of the evaporator condensate suirable for reuse in the pulp mill. Overall, a significant reduction in odor and chemical loss is achieved, as a direct result of the weak black liquor oxidation system. (Authors' abstract)

11059

U. Franzky

COUNTERING UNPLEASANT ODORS CAUSED BY ORGANIC OMPOUNDS. Staub (English translation), 28(3):33-42, March, 1968. 13 refs. CFSTI: TT 68-50448/3

Methods for the removal of highly odorous exhaust-air and waste- air components become more and more important. As a result of the high number of chemical processes and treatment methods, a correct selection of the purification processes is frequently very difficult. A survey of the most popular methods is, therefore, given and measure to be taken to improve conditions in a group of small plants are pointrd out. (Author's summary)

11136

Benforado, D.

INCINERATION HELPS CONTROL SOLVENT EMISSIONS. Air Eng., 10(9):20-2, 25, Sept. 1968.

The control of solvent emissions has been under study for many years in the Los Angeles County and San Fransisco Bay areas. To methods of incineration which have been found to provide satisfactory control of solvent emissions are the direct-flame and catalytic type. The characteristics of these systems which affect design elements are discussed. With each new installation, something more is learned about incineration. It has been found that a properly designed system offers a permanent solution to the air pollution control problem. Design of afterburner systems is discussed, and catalyst fouling is considered. A panel odor testin method is briefly presented.

11137

Brewer, Gerald L.

FUME INCINERATION. Chem. Eng., 75(22):160-165, Oct. 14, 1968.

Odors can be eliminated effectively by either catalytic or thermal incineration in nearly all cases where combustible gases or vapors are involved. Catalytic combustion is more economical, whether or not heat is recovered, however, thermal units are necessary when he exhaust stream contains catalyst poisons. Success in developing th most effective and low cost system rests in thorough consideration of design parameters. While there are guidelines to equipment design, it is often necessary to run laboratory tests to determine the degree of incineration that will produce odor elimination for individual installation.

11153

F. W. Hochmuth

ODOR CONTROL SYSTEM FOR CHEMICAL RECOVERY UNITS. Paper Trade J. 152 (40), 53-[illegible] ept. 30, 1968).

The problem of odor pollution as it relates to chemical recovery units operating on waste black liquor from the kraft process is discussed. Background information, such as furnace operation, source of odor, and direct-contact evaporation is given. Emphasis is placed on a new system, the air contact evaporation system, which permits odor free operation of kraft recovery units. Data to support the new system, such as performance comparisons, cost comparisons, and test results are presented. 152(40):53-55, Sept. 30, 1968. CONTROL METHODS: By-product recovery, Air contact evaporation, Odor counteraction, Chemical processes The problem of odor pollution as it relates to chemical recovery units operating on waste black liquor from the kraft process is dis

11158

E. J. Malarkey and C. Rudosky

HIGH EFFICIENCY KRAFT MILL PRECIPITATORS. Paper Trade J. 152 (40), 57-8 (Sept. 30, 1968).

A dry collection system for recovery boilers in kraft mills is compared with a dry-wet system. Although high efficiency electrostatic precipitators can minimize fall-out or snowing, the dry-wet system can virtually guarantee that it will not occur. Comparative installation and operating costs are presented.

11220

Tessier, K.C. and H. E. Bachman

FUEL ADDITIVES FOR THE SUPPRESSION OF DIESEL EXHAUST ODOR AND SMOKE. PART II: FIELD TRIALS. Preprint, American Society of Mechanical Engineers, New York, 5p., 1967. (Presented at the American Society of Mechanical Engineers Annual Meeting and Energy Systems Exposition, New York, N.Y., Dec. 1-5, 1968, Paper 68-WA/DGP-5.)

A combination of odor mask and barium containing additive in diesel fuel is effective in reducing smoke, odor and irritation from diesel exhaust. It has shown no injurious effects on fuel systems, exhaust systems or engines. Field testing of these additives in American diesel engines is discussed. The major implications of using barium additives in the fuel are discussed as well as possible mechanisms for their action. Of special interest is a description of the results of using the Ricardo, high speed cine technique to visually study the combustion of additive treated fuel. This technique shows in a spectacular way that smoke clearing occurs principally in the combustion chamber. (Authors' abstract, modified)

11234

K. C. Tessier, and H. E. Bachman

FUEL ADDITIVES FOR THE SUPPRESSION OF DIESEL EXHAUST ODOR AND SMOKE. PART I: PROPOSED MECHANISM FOR SMOKE SUPPRESSION. Preprint, American Society of Mechanical Engineers, New York , 8p., 1968. 28 refs. (Presented at the ASME Winter Annual Meeting and Energy Systems Exposition, New York, N. Y., Dec. 1-5, 1968, Paper 68-WA/DGP-4.)

A combination of odor mask and barium containing additive in diesel fuel is effective in reducing smoke, odor and irritation from diesel exhaust. It has shown no injurious effects on fuel systems, exhaust systems or engines. This paper discusses the engine evaluation of these additives in American diesel engines. The major implications of using barium additives in the fuel are discussed as well as possible mechanisms for their action. Of special interest is a description of the results of using the Ricardo, high speed cine technique to visually study the combustion of additive treated fuel. This technique shows in a spectacular way that smoke clearing occurs principally in the combustion chamber. (Authors' abstract, modified)

11673

Jones, K. H., J. F. Thomas, and D. L. Brink

CONTROL OF MALODORS FROM KRAFT RECOVERY OPERATIONS BY PYROLYSIS. Preprint, Public Health Service, Arlington, Va., National Air Pollution Control Administration, 20p., June 1968. 15 refs.

The pyrolysis and recombination steps of combustion in kraft mill processes were isolated for study because they encompass the reaction mechanisms responsible for producing malodorous compounds. Steady-state pyrolysis of concentrated black liquor was carried out over a temperature range of 480 to 1135 C to describe the process variables that would influence the design of a pyrolysis unit to minimize emissions of malodorous sulfur compounds from recovery operations. Several additional preliminary experiments were conducted using soda pulping liquor as a substrate with various inorganic sulfur salts added as the sole sulfur source for the purpose of describing production mechanisms for hydrogen sulfide as well as organic sulfur compounds. Results indicate the importance of temperature with respect to the relative production of malodorous sulfur compounds during the pyrolysis and recombination steps of kraft black liquor combustion. The requirement for definitive temperature control makes isolation of pyrolysis into a unit process attractive. The thermal efficiency of such a system coupled with the elimination of two unit processes currently in use further enhances such a design. The steady state data obtained in this study have provided the design parameters for a scale prototype system now under construction. The isolation and quantitation of organic sulfur compounds other than those most commonly reported suggest that they may be responsible for environmental perception when viewed in the relative framework represented by a simple odor model. The need for improved sampling and analysis of draft recovery process streams is indicated. (Author conclusions modified)

11843

National Swedish Inst. for Building Research, Stockholm, Sweden

BUILDING CLIMATOLOGY PART I: ODOR. RN-7/66, 64p., April 1966. CFSTI: PB-179562

To assist in investigating the possibility of measuring and evaluating odor, the following survey of the literature contains an account of the research reported on odor perception and odor analysis. The call for more precise measurements of odor is emphasised by its great influence on ventilation costs, which often amount to about one fifthof the total initial cost of a building, and can answer for one half of operating costs. With a view to investigating the possibilities of formulating more precise recommendations on ventilation psecifications and on the location of odor sources in communities, a survey of door literature of special interest for building research is presented. The first heading 'Odor general' covers literature of interest for all aspects. Under the three following headings the literature is distributed after the purpose of the investigation reported: 'Perception', 'Analysis' or 'Control'. Abstracts are given with most references.

12133

Korth, Merrill W.

EVALUATION OF A CATALYTIC MUFFLER ON A DIESEL BUS. Preprint, Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, Engineering Research and Development Section, 19p., Sept. 1964. 1 ref.

A catalytic muffler, was evaluated on a conventional diesel city transit bus. Based on a limited study, this muffler was reported to be effective in the removal of the typical diesel and acrid types of odors associated with diesel engine exhaust. The tests were performed at three different times during the interval required for the bus to accumulate 20,000 miles in normal operation. The most significant effects of the catalytic muffler were on odor intensity and total hydrocarbon. The typical diesel type of odor was greatly removed even after 20,000 miles of operation. Exhaust total hydrocarbon levels were lower with the catalytic muffler. An average of the results from four power conditions indicated removal of approximately 37% of the total hydrocarbon at the beginning of the test and 18% after 20,000 miles. Odor dilution ratio or smoke levels were not improved. (Author abstract modified)

12346

Pircon, L. J. and O. H. M. Wilder

ODOR CONTROL BY CATALYTIC OXIDATION OF RENDERED EXHAUST VAPORS. Bull. Am. Meat Inst. Found., no. 37, 22p., April 1958. 2 refs.

The feasibility and effectiveness of the catalytic combustion technique in eliminating odors from the rendering of animal tissue was studied. An electric heat source was used for convenience, although a gas or oil burner could also be used; the catalyst was of platinum-palladium. The apparatus and performance tests are described in detail. The temperature of the vapor entering the catalyst reached 700-800 F; the maximum flow rate was 1210 lb/hr/sq ft of transverse catalyst area for a normal packing depth of 3-3/4 in., although there was no indication that higher velocities could not be handled adequately. All offensive odors were eliminated from the cooker exhaust by passing through the catalyst; this was true all through the cooking and rendering cycle and was accomplished at a temperature considerably below the incineration temperature necessary if a catalyst had not been used. Considerable cost savings are foreseen with the use of this method.

12434

Marn, W. L.

A STUDY OF METHODS OF GREASE REMOVAL FROM COMMERCIAL KITCHEN EXHAUST AIR. American Gas Association, Inc., New York. Proj. 1A-12. RR-1323, 26p., Dec. 1960. 10 refs.

Methods of removing grease and odor from kitchen exhaust gases were investigated. Various basic designs were developed and evaluated for a grease vapor incinerator. Consideration was given to such factors as gas consumption, grease removal efficiency, size and application, and materials of construction. Experiments were conducted to evaluate the performance of commercially available filters and ventilators and the experimental designs of grease vapor incinerators built to determine the advantages and disadvantages of these methods of removing grease from exhaust air. The filters used were standard low velocity and low cost velocity models, 20 inches by 2 inches in size. There were five experimental models of grease vapor incinerators. These consisted of two basic designs: centrifugal separation of particles, and particle impingement on hot surfaces. Although conventional grease filters remove some grease from the kitchen exhaust air, they are limited. They do not remove all the grease from the air and must be frequently cleaned. It is possible to remove grease vapor and particles by impinging the vapor and particles on surfaces hot enough to incinerate the grease. The grease can be removed more completely by incineration than by the use of commercially available filters, which was evidenced by the comparative efficiencies. Because it is necessary to heat the baffles in the incinerator to temperatures high enough to burn the grease vapor, the grease vapor incinerator should be installed so that only the grease laden air passes through it. Any excess air will have a cooling effect on the baffles, reducing the efficiency, or they will require more heat to maintain the same efficiency. (Author summary modified)

12480

Yamamoto, Tadashi, Shozo Matsuda, Toshihide Okuno, Hideki Tanaka, Masahiko Tsuji

OFFENSIVE ODORS. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 53p.

Sixteen short reports on various aspects of odor pollution in Japan are presented. Analyses of amines and of odors from petroleum refineries, marine processing and fish handling plants, KP plants and vinyl chloride 'leather' factories, usually made by gas chromatography, are described, as well as the development of a container for collecting samples to be analyzed by this method. Surveys of the extent and composition of odor pollution, and of control programs, are given for Hokkaido and Tokyo. Other reports on control projects describe a method of eliminating odors from fish entrails by use of bamboo leaves, and countermeasures taken in an Osaka chemical plant. Odorimetry techniques by sensory perception in an odor-free room, by detection tubes, by the air dilution method, and by the saline solution equilibration method are reported. These documents are abstracted individually under APTIC numbers 17628 through 17641.

12482

Shigeta, Yoshihiro

THE PROBLEM OF ODOR NUISANCE. 6. THE BAD-ODOR NUISANCE AND ITS CONTROL. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1): 30-33, 1967. Translated from Japanese. 13p.

Offensive odors from industrial processes are a particular problem in Japan because industries are located close to residential areas and because most factories are too small to afford deodorizing facilities. Moreover, there has been no strict enforcement policy. Common sources of odors are chemical plants which process fish solubles into wheat or rice bran. Measures for controlling odors from these processes are discussed. One method is to adopt modern, closed equipment. Another is the installation of dedorizing apparatus. Deodorizing methods currently used by chemical plants and feed factories include combustion, adsorption, ion oxidation, ozone oxidation, rinsing, neutralization, and electric dust collection.

12506

Jones, K. H., J. F. Thomas, and D. L. Brink

MALODOROUS PRODUCTS FROM THE COMBUSTION OF KRAFT BLACK LIQUOR, V. STEADY STATE PYROLYSIS. Preprint, 30p., 1968 (?). 12 refs.

The variables associated with the steady state pyrolysis of unoxidized kraft black liquor as well as soda liquor combined with various sulfur salts were determined. The temperature range spanned 480 to 1135 C. Measurements included mass balances of gross pyrolysis products, the qualitative and quantitative analysis of fixed gases, the qualitative and quantitative analysis of sulfur, and the heat content of the gas and solid phases. The results showed that pyrolysis has promise as a unit process for the control of emission levels of malodorous combustion products. The requirement for definitive temperature control in the pyrolysis step of combustion was clearly demonstrated. The thermal efficiency of the pyrolysis process with respect to potential heat recovery was quite acceptable. The fact that the wet gas effluent was self sustaining with respect to flame propagation eliminates the need for direct evaporation which in turn would eliminate the need for black liquor oxidation. Possible design schemes for the application of pyrolysis were presented previously. The steady state data provided design parameters which allow the construction of a scale prototype system. The isolation and quantitation of organic sulfur compounds other than those most commonly reported suggested that there is a definite need for improved sampling and analytical methods for the identification and quantitation of the total array of malodorous compounds being emitted to the environment of kraft mills.

12658

J. L. Clement, J. S. Elliott

KRAFT RECOVERY BOILER DESIGN FOR ODOR CONTROL. Paper Trade J., 152(40):59-60, Sept. 30, 1968.

It is from the direct-contact evaporator, not the recovery furnace, that malodorous gases are emitted. Black liquor recovery furnaces can be operated with complete combustion of malodorous compounds. A recovery boiler design that will eliminate the direct-contact evaporator and is arranged to burn unoxidized black liquor supplied directly from the multiple effect evaporator to the furnace is presented. This design incorporated Scandinavian boiler design experience interpreted in terms of the North American kraft operations.

13072

Akamatsu, Isao and Hiroshi Kamishima

DEODORIZATION OF EXHAUST GAS IN KRAFT PULPING. 2. ON THE DEODORIZATION ACCORDING TO THE ADSORPTION AND ABSORPTION. (Kurafuto parupu seizo kotei haisui gasu no mushuka (dai nifo). Kyuchaku oyobi kyushu ni yoru akushu seibun no jokyo ni kansuru kisoteki kenkyu). Text in Japanese. Kami-pa Gikyoshi (J. Japan Tech. Assoc. Pulp Paper Ind.), 23(6):25-30, June 1969. 16 refs.

Adsorption and absorption capacities for malodorous components were estimated at 20 and 29 C. The adsorption capacity of activated carbon for methyl mercaptan was larger than that for dimethyl sulfide. For the hydrogen sulfide, activated carbon acted not only as an adsorbent but also as a catalyst, so adsorption capacity of activated carbon for hydrogen sulfide was larger than that for the other sulfur compounds. When a mixture of dimethyl sulfide and methyl mercaptan was adsorbed on activated carbon, the total adsorption capacity of activated carbon was a medium capacity between those for individual components. Because real kraft pulp blow gas is a mixture of methyl mercaptan, dimethyl sulfide and others, the adsorption of activated carbon for one was the mixture adsorption, and the adsorption capacity was 30 to 40%. The absorption capacity of polyvinyl chloride for dimethyl sulfide was moderately large, but dimethyl sulfide in air was absorbed only partially. The absorption reaction of ferric oxide for hydrogen sulfide resulted in water as a reaction product, therefore exact measurement of absorption was difficult. (Author abstract modified)

13334

Ruus, Av Lennart

INVESTIGATION OF ODOR ELIMINATION BY AB MORRUMS BRUK, MORRUM. (Undersokning av lukteliminering-sanlaggning vid AB Morrums Bruk, Morrum). Text in Swedish. Svensk Papperstid. (Stockholm), 66(15):554-557, Aug. 15, 1963. 1 ref.

An oxidation tower system for reducing odorous compounds formed during alkaline pulping was developed by the British Columbia Research Council and installed at AB Morrums Bruk, Morrum, Sweden, where its efficiency was investigated. The system involves the pumping of black liquor through the oxidation tower in the same direction as a gas mixture containing air, uncondensed gases from the turpentine recovery, and gases from the digester blow. After leaving the oxidation tower, the mixture is washed with chlorine and dilute sodium hydroxide in a scrubber before being vented into the atmosphere. Gas chromatographic determination of the amount of methyl mercaptan, dimethyl monosulfide, and dimethyl disulfide in the gas mixture before and after it had passed through the tower and scrubber reveals that the system removes more than 99% of the methylsulfides and more than 97% of the mercaptans. The greater part of these compounds is taken up by the black liquor in the oxidation tower; the rest is oxidized in the scrubber. The concentration of the odorous compounds in the outlet from the scrubber is very low and their smell can be characterized as 'faint'. About 90% of the sodium sulfide in the black liquor is oxidized in the oxidation tower. (Author abstract modified)

13398

Fones, R. E. and J. E. Sapp

OXIDATION OF KRAFT BLACK LIQUOR WITH PURE OXYGEN. TAPPI, 43(4): 369-373, April 1960. 6 refs.

Oxidizing black liquor from a kraft cooking process reduces kraft- mill odor, reduces corrosion in the evaporators, and minimizes the loss of sulfur compounds in the recovery process. Oxidation of kraft black liquor in a pressure vessel with pure oxygen as a possible means of circumventing some of the foaming problems attending the oxidation of black liquor is investigated. Experimental investigations tested the feasibility of oxidizing black liquor with pure oxygen either after separation from the pulp or just prior to blowing at the end of a normal kraft cook. All cooks were carried out in a laboratory experimental digester. Oxidation of the pulp alone resulted in the pulp darkening and the lignin content increasing. Oxidation of the black liquor alone would require the reducing the sodium sulfide content to prevent the formation of sodium thiosulfate. Costs of reducing the sodium sulfide content and the cost of the oxygen ($1100 per day) were too expensive for current applications. Although oxidation of pulp and black liquor at the end of a normal kraft cook results in complete oxidation, oxygen consumption rates are high and pulp strength and color are adversely affected.

13551

Faith, W. L.

AIR POLLUTION ABATEMENT. SURVEY OF CURRENT PRACTICES AND COSTS. Chem Eng. Progr., 55(3):38-43, March 1959. 8 refs.

Pollutants and control methods of the chemical manufacturing, pulping, petroleum refining, steel, food, and cement manufacturing industries are reviewed. Chief pollutants from the chemical industry are dilute vent gases, acid mists, waste sulfides, nitrogen oxides, combustible wastes, and dust. Vent gases are best controlled by catalytic oxidation, sulfides by caustic scrubbers, nitrogen oxides by catalytic reduction, combustible wastes by incineration, and dust by filtration. No standard procedure has been adopted for abatement of acid mists. Pulp and paper industry pollutants are fly ash, dust and odors. Electrostatic precipitators, dust scrubbers, and spray towers are used to combat these problems. Air pollution by the petroleum refining industry is caused by sulfur compounds and hydrocarbon loss. Sulfur compounds can be reduced by absorption and hydrocarbons by several control methods. The main pollutant from the steel industry is dust, which can be controlled by electrostatic precipitators and wet scrubbers. The main problem of the food industry is control of odor, which is combatted by activated carbon adsorbers. Dust from cement industries is best controlled by glass fabric bag filters or cyclone collectors. Costs for 1959 are given for the various control methods.

13697

Obering, E. Albrecht

SLUDGE INCINERATION IN THE FLUIDIZED BED FURNACE. (Schlammverbrennung im Wirbelschichtofen). Text in German. Chem. Ing. Tech., 41(10):615-619, 1969. 2 refs.

Sewage sludge disposal becomes an ever greater problem since dump sites are becoming scarce and awareness of the danger of uncontrolled dumping is spreading. Disposal by incineration decreases the volume and leaves sterile ash and inert odorless gases. Sludge incineration must be preceded by mechanical dehydration to avoid emission of volatile organic sludge components with the waste gas and to permit autonomous combustion. To achieve the latter goal, the combustion temperature must be high, the excess air in the reaction chamber low, the incineration complete, and the temperatures of the waste gases and vapors low. However, the waste gas temperature may not drop below 750 C if odors are to be avoided and if the residues ought to be sterile. To solve the problem, the fluidized bed furnace must be used. The sludge falls into a bed of turbulent sand particles where it is dried, degassed, and ignited. The temperature of the waste gas at the combustion chamber outlet is 800 to 900 C. It is cooled in an air preheater and the heat is returned to the combustion chamber. In the subsequent dust collector, the mineral sludge components are separated as dust either by a wet or dry process and tapped off to an ash pit. The turbulent sand particles are slowly eroded and carried off with the ash. They are replaced by larger ash particles and by sand brought in by the sewage sludge. The furnace has no movable parts aside from the charging facility and the ventilators so that wear and tear are low. The city of Lausanne has operated such a fluidized bed furnace since 1965. The furnace burns 2600 kg of dehydrated sludge per hour (max. water content 60%). Part of the waste gas is used to heat the combustion air and the rest goes to a boiler. The waste gases are cleaned in cyclone separators and electrostatic precipitators.

13772

Guest, E. T.

DEVELOPMENTS IN BLACK LIQUOR OXIDATION. Pulp Paper Mag. Can., 66(12):T 617-T 622, Dec. 1965. 8 refs. (Presented at the Annual Meeting of the Pacific Coast Branch, Tech. Sect., Canadian Pulp and Paper Assoc., Harrison Hot Springs, B. C., May 9-11, 1963.)

The overall status of black liquor oxidation in the West Coast kraft pulp industry is reviewed. The most prevalent oxidation techniques are the Collins system, the B. C. Research Council system, and the Troebeck-Ahlen system. The Troebeck-Ahlen and the Collins type systems oxidize by forcing air through the liquor to make a controlled volume of foam. The B. C. Research Council unit operates with air blowing concurrently with the liquor over specially designed plates. Other systems use packed columns with either concurrent or countercurrent air, compressed air in a tank of liquor, or compressed air in a pipeline. The Crofton pilot plant has incorporated a more positive pattern of liquor flow to combat difficulties in maintaining pressure drops, an integral foam box with carryover space, a new type of combination cyclone with a foam breaker, and a simplified square design into its system. The several advantages to black liquor oxidation include a reduction of odor in the evaporator condensate and recovery stacks, reduction in sulfur losses, and less corrosion of the mild steel evaporator tubes and strong black liquor piping. Reduction in the recovery furnace odor emission can only be obtained when a furnace is not overloaded and therefore operated with sufficient air. 13772 Guest, E. T.

13812

Grillot, R. and A. Ladam

A FEW METHODS USED IN FRANCE TO PREVENT ODOURS. (Quelques methodes utilisees en France pour la prevention des odeurs). Text in French. Pollut. Atmos. (Paris), 11(41):1-14, Jan./ March 1969. 59 refs.

A consideration of the difficulty of establishing a scientific basis for the detection of pollution by odors is followed by a review of methods used in France to prevent odors. These include ventilation, adsorption, thermal and catalytic combustion, dry and wet processes, absorption, ozonization, and the use of masking and neutralizing agents. Characteristic examples of applications are given for each method together with available economic data. Factors interfering with the adaption of deodorization methods are the high cost of appliances and agents, the limited effectiveness of methods, and the absence of legislation on maximum contents. A classified bibliography is included. (Author abstract modified)

13971

Benforado, D. M., W. J. Rotella, and D. L. Horton

DEVELOPMENT OF AN ODOR PANEL FOR EVALUATION OF ODOR CONTROL EQUIPMENT. Preprint, Air Pollution Control Assoc., 27p., 1968. 12 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Assoc., St. Paul, Minn., June 23-27, 1968.)

The use of a trained odor panel of six to eight members was found to have considerable practical applicability in the measurement and evaluation of industrial odors and control equipment. The panel was tested by the syringe dilution technique, in which odor strength is measured in terms of the 'number of dilutions of clean air' required to reduce the 'sample plus clean air mixture' to 'no odor'. Panel members were asked to inhale and evaluate three different dilutions of field samples of stack gas emissions; only positive or negative response as to the presence of odor in the syringe sample was reported. The odor strength of the exhaust gases was reported in odor units per standard cubic foot (scf); the odor unit was defined as the ratio of the cubic feet of clean air needed to dilute each 'cubic foot of contaminated effluent' so that 50% of the panel does not detect any odor in the diluted mixture. Results showed that if the odor strength of the stack gas can be reduced to less than 150 odor units per scf, preferably in the range of 25-50 odor units per scf, odor nuisances in a community can be prevented. By converting this measure to an odor emission rate, it appears that up to about one million odor units per minute is acceptable to avoid odor complaints from a single stack or for the combined effluent from a group of stacks. The odor panel method was used to judge the effectiveness of various types of ovens as control equipment. Results showed, for example, that with the use of wire enameling ovens, incineration produces a satisfactory effluent at 1400 F but is unsatisfactory at 1000 F. The method was judged to be a simple, inexpensive, and practical tool for quantitatively analyzing odors and for monitoring stack emissions to determine the efficiency of control equipment, and provides an easy method for obtaining field samples for laboratory analysis.

14004

Franzky, Ulrich

COUNTERACTING OFFENSIVE ODORS CAUSED BY ORGANIC COMPOUNDS. (Bekaempfung von Geruchsbelaestigungen, die durch organische Verbindungen verursacht sind). Text in German. Staub, Reinhaltung Luft, 28(3):113-119, March 1968. 13 refs.

The importance of removing odorous components from waste air and exhaust gases is now recognized, but the selection of an appropriate purification process is complicated by the proliferation of chemical processes and treatment methods. A survey of the most popular methods is given and measures that can be taken to improve conditions in a small plant are pointed out. (Author summary modified)

14013

Maria, Gubola

ON THE PROBLEMS OF THE ODOUR-PARAMETER OF AIR POLLUTION. (A legszennyezodes szagparameterenek kerdeseirol). Text in Hungarian. Idojaras (Budapest), 73(1):38-43, Jan.-Feb. 1969. 14 refs.

One of the important aspects of air pollution which is often neglected is the odor of pollutants, an aspect which can no longer be disregarded. The sources of odors, the quality and intensity of odors, methods of odor assessment (subjective observation, instrumental measurements, mathematical determination), and methods for the elimination of odors are reviewed. (Author summary modified)

14094

Shah, I. S.

NEW FLUE-GAS SCRUBBING SYSTEM REDUCES AIR POLLUTION. Chem. Eng., 1967:84-86, March 27, 1967.

Chemico's new two-stage scrubbing system enables pulp mills to greatly improve overall dust collection efficiency and to meet stricter air pollution regulations. Flue gases from the recovery boiler enter the two-stage system, which consists of evaporator, scrubber, separator, and cooling tower, and are vented to the stack 99% cleaner and 500-600 F cooler. Concentrated black liquor is further concentrated to 60-70% solids content by direct contact with flue gases in the Venturi evaporator. With about 40 in. H2O static pressure for the system, the outlet dust leading can be reduced to 1 lb/ton of pulp. The two stage system provides greater heat recovery because it exhausts stack gases at temperatures below 120 F, as compared to 325 F from electrostatic precipitators, and 180-190 F from single-stage scrubbing systems. Chemico has also perfected two oxidation systems for black liquor that reduce the amount of H2S emitted to atmosphere. One is for weak black liquor and the other for strong black liquor.

14113

Murray, F. E.

AIR POLLUTION FROM BIVALENT SULFUR COMPOUNDS IN THE PULP INDUSTRY. Preprint, Engineering Institute of Canada, March 1968, 16p., 10 refs. (Presented at the Banff Pollution Conference, Banff, Alberta, Can.)

In the kraft process of producing chemical cellulose from wood chips, the chips are cooked in a solution containing sodium hydroxide and sodium sulfide in about a four-to-one proportion. This method produces much greater air pollution, in the form of highly malodorous compounds, than the alternative sulfite processes. The three primary sources of odor production in a kraft pulp mill are the digestion process, the direct-contact evaporator, and the recovery furnace. In the digestion process, control must be effected on the noncondensible gases from the digester and blow tank, from the multiple-effect evaporators, and on the foul condensates that are formed in contact with these gases. The emission of hydrogen sulfide from black liquor during direct contact evaporation can be very substantially reduced by oxidation of the sulfide. The problem of the recovery furnace is one of good operation and combustion control within the furnace design capacity. Present laboratory studies are expected to lead to continuing improvement in the control of odorous emissions from kraft pulping operations.

14118

Markant, H. P.

THE MEAD RECOVERY PROCESS. TAPPI, 43(8):699-702, Aug. 1960. 2 refs. (Presented at the 45th Annual Meeting of the Technical Assoc. of the Pulp and Paper Industry, New York, Feb. 22-25, 1960.)

The Mead neutral sulfite recovery process consists of two basic stages: the total carbonation stage and the sulfiting stage. Green liquor from a storage tank is fed to a precarbonation tower, where it comes in contact with 15% of the total gas in the carbonation tower. When the gas enters the precarbonation tower, it contains H2S that was released in the carbonation tower. This is reabsorbed by the green liquor, and H2S-free gas is discharged to the atmosphere. The precarbonated liquor is passed to the carbonation tower, where it absorbs CO2 and releases H2S. The gas loses CO2 and gains H2S. The next phase of the process takes place in a sulfiting tower. Here the SO2 in the flue gas from a venturi scrubber cyclone separator is scrubbed with the carbonated liquor. The addition of more contact surface in the absorption system has reduced odors from the process and brought them within acceptable limits. Improvements in the venturi scrubber and the installation of a droplet agglomerator in the sulfiting tower have reduced the amount of particulate matter leaving the process to an extremely low level. The total stack gases are continuously monitored for SO2 and H2S, and concentrations are not permitted to exceed 0.03 and 0.01%, respectively.

14203

Iida, Suetoshi, Yoshio Marushima, and Nobuyasu Hasebe

METHOD FOR THE REMOVAL OF HYDROGEN SULFIDE IN THE AIR OF WASTE GAS. (Tokyo Gas Kabushiki Kaisha, Inc., Tokyo) U. S. Pat. 3,459,495. 4p., Aug. 5, 1969. 3 refs. (Nov. 4, 1965, 5 claims).

A method is described for removing hydrogen sulfide from the air or from combustible waste gases by a wet process and recovering sulfur. The method comprises passing hydrogen sulfide-containing gases through an aqueous alkaline medium containing an amount between 0.001 to 0.5 moles of sodium 1,4-naphthoquinone-2- sulfonate in the presence of molecular oxygen, thereby desulfurizing the hydrogen sulfide-containing gases and at the same time regenerating the catalytic naphthoquinone. Thus, the method, by introducing an acidic radical into quinones, hydroquinones, or their salts, employs as an absorption liquid an aqueous solution of a catalytic compounds, the normal oxidation- reduction potential of which is in the range from 0.45 to 0.70 v at 25 C. The catalytic compound is water-soluble, not polymerizable, and must be easily reduced by hydrogen sulfide; this reduced compound must in turn be easily oxidized by the air. The method is considered applicable to the desulfurization of hydrogen sulfide-contaminated air, to contaminated exhaust gases from certain chemical plants, and to combustible gases from the fermentative treatment of biological and other waste products. Details of the process and of the chemical reactions involved are presented.

14341

Lunche, Robert G.

FUME AND ODOR DESTRUCTION BY CATALYTIC AFTERBURNERS. Franklin Inst. Research Labs., Philadelphia, Pa., Materials Science and Engineering Dept. and Public Health Service, Durham, N. C., National Air Pollution Control Administration, Proc. First Natl. Symp. on Heterogeneous Catalysis for Control of Air Pollution, Philadelphia, Pa., Nov. 1968, p. 297-320. 6 refs.

The operating and design aspects of the catalytic afterburning process are reviewed, and its application and effectiveness are discussed on the basis of the experience of the Los Angeles County Air Pollution Control District in testing a wide variety of catalytic afterburners in industrial use. Because of certain operating characteristics of these afterburners, they represent a partial oxidation process which produces compounds in the treated effluents that are often more offensive and odorous than the original fumes and odors. Investigations by the District show that partial oxidation produces olefinic and other oxidation products that often increase the eye-irritating, photochemical smog-forming potential of treated effluents to levels greater than those of the original fumes and odors. In general, an afterburner must oxidize 90% or more of the carbon in the entering materials to CO_2 to be judged effective. On the basis of the District's own experience and reports of others, the actual performance of catalytic afterburners for reducing many fumes and odors is considered inadequate. Without an advance in performance, it does not seem likely that catalytic afterburners will be able to comply with Los Angeles County's organic emissions standards unless the operating temperatures are at a level that renders the catalyst unnecessary. 14341 Lunche, Robert G.

14354

Strauss, W.

DIRTY AIR CAN CAUSE PLANT SHUTDOWNS. Factory and Plant, p. 18-23, Sept. 1968. 2 refs. (Also: Chem. Process. (Chicago)).

Removal of particulates from the environmental air of industrial sites by fiber filtration is described. In such processes, particles of the same or larger dimensions as the diameter of the fibers in the collecting medium are generally captured by inertial impaction and interception, while smaller particles are captured by their diffusion to the fiber surface. It is considered good practice when collecting fine particles to have a relatively deep bed, with fibers as fine as is feasible for a stable bed structure. The velocity through the bed must be based on an economic balance, with smaller bed sizes, higher pressure losses, and lower efficiency being offset against greater costs and other process considerations. Air conditioning systems can be modified for the collection of fine particles by the use of pleated filter media or the two-stage positive corona electrostatic precipitator, which produces almost none of the nitrogen oxides and ozone caused by the usual industrial negative corona precipitator. Various types of filters are reviewed, including fibrous and viscous filters. The deep-bed filter, consisting of a 2-in. bed of glass fibers and fire-resistant felt filters, is considered relatively effective. Very high efficiencies in collecting very fine dusts, such as methylene blue, are obtained with the 'Absolute' filter, which also has the advantage of eliminating the bulk usually associated with high-efficiency filters; its cost, however, remains high. Apart from the primary function of air filters in preventing contamination and subsequent deleterious effects on equipment, an important secondary consideration is their role in industrial safety to remove the fine airborne dust, particularly of metal origin, which represents a fairly serious health hazard to workers. Removal of odors and organic vapors from air streams by adsorption of the vapors on the micropores of a solid, most commonly activated carbon, is also described. 14354 Strauss, W.

14453

Krane, Dieter

EMISSION PROBLEMS IN CHICKEN FARMS. EXPERIENCES WITH THE ELIMINATION OF DISAGREEABLE ODORS. (Emissionsprobleme durch Huehnerfarmen. Erfahrungen ueber die Beseitigung schaedlicher Geruchsstoffe.) Text in German. Wasser Luft Betrieb, 12(8): 482-483, Aug. 1968.

High-temperature drying of chicken excreta usually leaves disagreeable odors due to decomposition of various nitrogen-containing organic substances, mainly proteins, amines, and albumins. Proteins are not heat-resistant and begin to decompose at temperatures as low as 100 C. Thus, any odor-preventing drying method must operate at temperatures below 100 C. Since none of the conventional methods such as afterburning, decomposition by bacteria, ozonizing, etc. operates odorlessly, a new method has been developed. The installations necessary for the drying of the excreta comprise a sheet steel trough in which a bundle of pocketed pipes slowly rotates. The heaters installed in the pipes develop pipe wall temperatures of no more than 140 C so that the manure itself never gets any warmer than 70 C. The liquid material slowly moves on in the trough while constantly being turned. The fumes are caught by an exhaust fan. The excreta is granulated in the dryer to grains of 1 to 3 mm diameter. The dried material is blown into a storage bin. Since the fine parts of the dried excreta are the odor carriers, they are eliminated in a wet scrubber. The separated particles are returned to the wet excreta at the entrance of the dryer.

14488

Shoji, H., K. Nishida, T. Denda, Y. Koyama, and T. Ando

REMOVAL OF OFFENSIVE COMPONENTS BY THE DEODORIZER. (Dasshu zai ni yoru aku shu seibun no jokyo koka ni tsuite). Text in Japanese. Nippon Eiseigaku Zasshi (Japan J. Hyg.), 24(1):83, April 1969.

The efficiency of an easily-used spray deodorizer comprising vegetable oil, perfume, and surfactant was determined in an experimental deodorizing chamber. A spray of 50 to 100 g/min removed 50 to 91.2% of ammonia (45 to 100 ppm) at a flow rate of 2.2 to 5.6 cu m/min. A spray of 20 to 60 g/min removed 60 to 89.7% of hydrogen sulfide (125 to 250 ppm) at a flow rate of 2.0 to 2.4 cu m/min. Measurements of the deodorizer's ability to counteract odors in sealed cars transporting human excretion show a 54.1 to 93.5% removal efficiency for methyl mercaptan and diethyl sulfide. Only 9.1% removal efficiency was obtained for di-n-propylamine. These measurements suggest that the deodorizer not only neutralizes malodorants but also effects some occlusion of components.

14609

McLouth, B. F., H. J. Paulus, and A. J. Roberts

INCINERATION OF EPOXY GLASS LAMINATES TO RECOVER PRECIOUS METALS. American Society of Mechanical Engineers New York Incinerator Div., Proc. Natl. Incinerator Conf., New York, 1968, p. 171-175. (May 5-8).

Recovery of precious metals from electrical circuits printed on epoxy-impregnated fiberglass laminates was carried out by incineration of the scrap and rejected printed circuits at controlled temperatures, which resulted in the liberation of a considerable amount of unburned hydrocarbons and obnoxious odors into the atmosphere. The glass laminates consisted of approximately 65% fiberglass (by weight) and 35% epoxy resins. The material contained no chlorines and not more than a trace of sulfur, but 16% petra-bromo had been added to the resins to permit the use of the final product under various ambient temperatures. In addition, there was variance in type and consistency of the epoxy scrap. Based on information obtained by research on the combustion characteristics of the material, a prototype unit was constructed and tested. After successful testing of the prototype unit, a new incinerator was installed that solved the problem of hydrocarbon and odor emission. A control system was designed that should assure proper burner operation and unit temperatures and at the same time be flexible in case adjustments become necessary in the new unit. The new incinerator simplifies recovery of the precious metals due to more consistent ash quality. Polyesters and other plastics, as well as wool and vinyls have been burned in this incinerator, all with equal success.

14671

Kurmeier, Hans H.

REMOVAL AND DEODORIZING OF GASEOUS EMISSIONS FROM FISH MEAL AND OTHER FACTORIES. (Die Beseitigung und Desodorierung gasfoermiger Emissionen von Fischmehlfabriken und anderen Betrieben). Text in German. Wasser Luft Betrieb, 5(1):7-10, Jan. 1961, 1 ref.

The development of a new deodorizing process for emissions from fish meal plants is described. There are two types of emissions in the fish meal industry, namely, those from steam driers and those from air lift driers. The former are alkaline waste gases composed mainly of water, odorous bases, and carbon dioxide. Waste gases from air lift dries are acidic and contain water, and sulfur dioxide. By scrubbing the waste gases from the air lift drier with water, almost all odorous bases bound to SO2 could be removed. Experiments showed that the remaining odors disappeared when the waste gas was passed over CaCO3 in the presence of SO2. By raising the pH, the odorous compounds were liberated and the fishy odor returned. Thus it is seen that the odors are chemically bound to CaCO3. Based on this finding, a scrubbing tower was constructed filled with limestone to a height of 600 cm and wood which is constantly sprayed with water. The gases from the air lift drier after passing through the scrubber had a slightly bluish color but no odor. The waste scrubbing water contained 11.8% SO2 at a pH of 6.1 compared to ph 6.85 in the entering water. Drum driers are likewise discussed briefly for comparison, although they are only used today in Japan.

14687

Walker, A. B.

OPERATING PRINCIPLES OF AIR POLLUTION CONTROL EQUIPMENT. GUIDELINES FOR THEIR APPLICATION. American Institute of Chemical Engineers, New York, N. Y., American Inst. of Mining, Metallurgical and Petroleum Engineers (AIME), New York, N. Y., American Society of Civil Engineers, New York, American Society of Heating, Refrigerating and Air Conditioning Engineers, New York, American Society of Mechanical Engineers, New York, and American Soceity for Testing and Materials, Philadelphia, Pa., Proc. MECAR Symp., Design and Operation for Air Pollution Control, New York, N. Y., 1968, p. 49-74.

Equipment for emission control at the source comprises two categories: particulates and gases and odors. Equipment for control of particulates falls into four generic types: filters (principally fabric), electrostatic precipitators, dry inertial collectors (principally cyclones), and wet scrubbers. For control of gases and odors, there are wet absorbers (scrubbers and packed towers), dry adsorbers, and thermal or catalytic incinerators. In cases of complex emissions, these devices can be combined. The basic operating principles of these devices are examined and the critical factors in their application are identified. The latter involves certain basic data requirements. As an absolute minimum, the following must be defined: the volumetric flow rate of gases; the gas temperature, pressure, and humidity; the particulate form and concentration; the particulate size distribution and specific gravity; the particulate bulk electrical resistivity (dry); the required removal efficiency; and process constraints with regard to the use of water. From these basic data, it is possible to perform an initial screening on the type of system required. This screening will define technically feasible alternate solutions. Selection of the optimum equipment requires a detailed analysis of additonal technical and economic factors, including capital investment, operating costs, and costs of capital.

14692

Tuerkoelmez, S.

NEW METHOD FOR WASTE GAS CLEANING. ELIMINATION OF ODORS BY EXCHANGE ADSORPTION WITH ARTIFICIAL RESIN ION EXCHANGERS. PART I. (Neues Verfahren der Abgasreinigung. Beseitigung der Geruchbelaestigungen durch Austausch-Adsorption mittels Kunstharz-Ionenaustauschern. Teil I). Text in German. Wasser Luft Betrieb, no. 11:737-743, 1965.

For the removal of odors from industrial waste gases, the use of artificial ion exchanger resins is suggested. The reaction takes place in the gas phase in the case of inorganic waste gases and in the liquid phase for organic compounds. Four types of exchangers, IR-45(OH), IRA-410(OH), IRC-50(H), and IR-120(H), were successfully tested with phenols, mercaptans, bromides, fluorides, cyanides, nitriles, chlorides, SO2, and a number of organic compounds. Fluorides, cyanides, chlorides, and SO2 could be completely removed. Pre-adsorption with alkaline earth hydroxides in scrubbers was used only in the case of phenols.

14757

Meites, Leonard

WEB PRINTERS AND AIR POLLUTION CONTROL. Web Printer, 1(6):1-7, 1969.

Air pollution from web printing plants consists mainly of a smoke problem, which is relatively simple to control with afterburners, and an odor problem, which presents considerable control difficulties. The most practical means of counteracting odors from paper coatings, ink solvents, improperly adjusted gas burners, and soiled papers is by either catalytic or thermal combustion. The first works best with a pure gas stream from the press dryer; in practice, however, the effluent of a press dryer may have impurities which can cause trouble with the catalyst and must therefore be considered when the system is designed. Direct flame combustion can handle impurities in the dryer effluent since its temperature range is from 1000 to 1400 F. The initial cost of a catalytic afterburner system is higher than that of a thermal system, but its operating costs are usually considered lower, although recently there has been some controversy on this point. The possibility of controlling pollution by using mild and low aromatic solvents is briefly discussed; the inks now used in web presses contain photochemically-reactant hydrocarbon solvents which violate regulations such as Rule 66 of the Los Angeles County Air Pollution Control District, and therefore require the installation of highly efficient afterburners. It is noted that the cost of air pollution control are mitigated somewhat because good afterburners reduce condensate formation on oven walls and thus increase production and improve printing quality.

14895

Sallee, Elgin D.

FOUR TYPES OF AIR POLLUTION. Mod. Lithography, 36(9):79-81, 84, 87, Sept. 1968.

Air pollution emissions and control methods involved in the operation of coating ovens for metal decorating are reviewed. Particulates or smoke from litho or coating oven exhaust stacks consist primarily of breakdown by-products of the resin or drying oil in the coating or ink during the bake. Several methods of reducing plume density are mentioned; it is noted, however, that these apply mainly to diluting stack gases and simply reducing their visibility, rather than to decreasing the absolute amount of emissions. Odorous pollutants are the most difficult to control; the bulk of the odors from coating ovens come from aldehydic and other resin-breakdown products that have very low odor thresholds despite their low concentrations in stack air, rather than from the more frequently blamed solvent vapors which have much higher concentrations but also higher thresholds. No one method of odor control has been found completely satisfactory, but the most success has been obtained by incinerating stack gases at 1300 F or more. Vapors of many of the solvents and thinners used in coating ovens are photochemically reactive and thus of major concern in areas where other conditions tend to promote smog formation. Because of stringent regulations in the Los Angeles area, all coating ovens must have solvent-elimination devices if the solvent amounts to more than 15 pounds per day. Some general discussion is given to the problems of applying various control methods to coating ovens, including high and low temperature incineration, catalytic oxidation, and scrubbing and adsorption systems.

14940

Tada, Mitsuru

INDUSTRIAL WASTE INCINERATION BY FLUIDIZING SYSTEM. (Sangyo haikibutsu no ryudoshokyakuho). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 5(7):529-533, July 1969.

Fluidizing systems, which are widely applied to petroleum and mineral combustion, are highly efficient. The outstanding merits of this system are a capacity of 500 kg/cu m-hr incineration; the ability to incinerate low-calorie wastes (1000/kcal/kg, water 70%) without catalysts; perfect combustion with kiln heat around 750 C; no stack smoke or odor problems; simplicity of structure, with no vibrations inside the kiln and constant and stable internal heat; availability of electric power, produced though the process in large-scale (400 t/day) kilns of this system; convenient operation requiring no heavy or intensive labor; and economical maintenance. The system has a wide range of applications, including waste incineration in the chemical, food processing, and petroleum industries, and excrement and sludge treatment. For example, the liquid wastes from paper manufacturing plants that used to be discharged into rivers, bays, or seas and caused problems for agriculture, fishing, and shipping may now be incinerated, removing all the organic matter contained in pulp wastes, and chemical compounds such as Na2SO4 or Na2CO3 may be recovered and reused in kraft pulp production. Adaptation of this system to watery wastes in the food and chemical industries has the advantages of deodorizing wastes and recovering ash for use as fertilizer. The system can be adapted to petroleum and petrochemical wastes and to high-temperature wastes.

14951

Fujii, Shoichi

A RESEARCH REPORT ON THE IMPROVEMENT OF AIR CIRCULATION INSIDE A RAILROAD CARRIAGE. (Syanai kanki kaized no kenkyu ni tsuite). Text in Japanese. Kuki Seijo (Clean Air-J. Japan Air Cleaning Assoc., Tokyo), 7(1):4-31, April 1969. 10 refs.

The purpose of this research was to examine the air pollution inside a highly modernized railroad carriage using the new Tokaido Line as an example. It was also aimed at finding a device to solve the problem. In the first test, the dust was measured using a dust meter, an air filter, a hygro-thermometer, and deodorant musk inside the controlled atmosphere carriage. In the second test, the air circulation in the carriage under operating conditions was studied. This carriage was equipped with a dust meter, an ionizer, an ion density meter, and an air filter unit with active carbon. The third test studied the influence of cigarette smoking in a carriage. Results show that the 35 cu m/min of fresh air provided by air circulation was sufficient in terms of CO2 supply. Pollution increased while the train went through a tunnel. An ordinary ionizer could not cover a wide enough area in the carriage. Odor in the train was mainly caused by cigarette smoke, and a high-fidelity air filter was recommended to diminish the odor and dust density. Two problems left to further study are pressure in the high-fidelity air filter and economic feasibility of operation.

14956

Tanaka, Isamu

AN EXAMPLE OF INDUSTRIAL WASTE TREATMENT. BRIDGSTONE TIRE INDUSTRY, YOKOHAMA PLANT. (Kagakusangyo haikibutsu no shori jitsurei. Brigiston taiya (kabu) Yokohama kojo niokeru ichirei). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 5(7): 535-540, July 1969.

A newly-designed kiln (SP type) for industrial rubber and urethane waste treatment is described. The SP type-kiln was first examined with respect to stack smoke and toxic gas, and treatment cost reduction. Perfect incineration of synthetic rubber and foaming urethane is characteristic of this kiln. The main feature of the kiln is that the waste and organic gas produced during combustion in the incinerator is directed to a second incinerator, heated up to 1000-1600 C, and finally discharged in dustless and odorless form. The SP type-kiln is fireproof and is designed to keep the kiln heat constant. Kiln no. 1 was designed to treat synthetic solid wastes and rubber-urethane wastes with a capacity of 1 t/7 hrs, and kiln no. 2 for metallic materials of rejected rubber articles at low temperatures with a 1 t/7 hrs capacity. Operating efficiency of kiln no. 1 is reported as highly reliable and effective. Combustion rate was constantly 115-125 kg/sq m-hr and 977,500-1,062,500 kcal/sq m-hr in the case of synthetic rubber. After perfect combustion, the standard smoke volume was 0-0.1 g/N cu m, and Ringelmann density was 0-0.1 degree. These figures are far below the standard stipulated in the Air Pollution Control Law. Odors were removed by 700-800 C heat in the kiln.

14967

Hein, G. M. and R. B. Engdahl

A STUDY OF EFFLUENTS FROM DOMESTIC GAS-FIRED INCINERATORS. (American Gas Association, Inc., New York, Proj. DG-3M, 27p., June 1959. 24 refs.

Measurements were made of the effluents from nine domestic gas- fired incinerators, including two new prototype models, five new commercial units, and two older units. Standard test charges that typified wet domestic wastes and dry combustible materials, and two special refuse mixtures were burned. A free-standing chimney provided natural draft for the units. Sampling and analytical techniques were based on recognized methods. The concentrations in ppm in the flue gas and the emission rates in pounds per ton of refuse burned were determined for aldehydes, nitrogen oxides, organic acids, ammonia, and hydrocarbons. Grain loadings and emission rates were determined for particulate matter which included tarry organic materials. Odor and smoke density were also determined. Results demonstrated that significant reduction in emissions has been achieved through recent improvements in incinerator design. When wet domestic wastes are incinerated in new units, of up to 6-fold decreases in the rate of aldehyde emissions are achieved. Decrease in organic acids is 3-fold; decrease in saturated hydrocarbons is 8-fold. Although nitrogen oxides have increased 3-fold because of increased gas in the afterburner, their concentration is still lower compared to other combustion sources. Smoke, odor, and particulate matter emissions decreased to acceptable levels. Comparison of these emission rates with those from municipal incinerators shows that the new improved gas-fired domestic incinerators have lower particulate emissions, and, in general, equally low emissions of gaseous pollutants. Emissions from improved gas-fired units were in most cases lower than those from other incinerators and large gas- and oil-fired industrial heating units; they were much lower than those from automobile exhaust. The results of the study provide a basis for modification of the present restrictions in certain areas on the use of gas-fired domestic incinerators and for confirmation of their present acceptance in other areas.

15153

Schoeffmann, Ernst and Willi Schneider

A METHOD FOR ELIMINATION OF DISAGREEABLE ODORS FROM FOOD INDUSTRIES. (Ein Verfahren zur Beseitigung von belaestigenden Geruchsimmissionen aus Lebensmittelbetrieben). Text in German. Staedtehygiene (Uelzen/Hamburg), 20(10):246-248, 1969.

The efforts to deodorize odors emitted by a fish frying plant are described. The plant fried fish in four pans with each containing 40 liters oil. The waste air was initially drawn off and discharged through a chimney 18 m high; the fan had a capacity of 4000 cu m/hr. Since this proved to be insufficient to eliminate odors, deodorizing chemicals with the trade name 'Alamaske' were added to the waste air; thorough mixing neutralized the disagreeable odors. A 1% aqueous solution of the deodorant was injected tangentially into the flow of waste air at a rate of 3 l/hr. The injecting device shuts off operation of the fan as soon as the solution is consumed. Installation and operating costs of this deodorizing device are discussed.

15170

Tanaka, Isamu

A PRACTICAL EXAMPLE OF OILY WASTE INCINERATION. (Yusei sangyohaikibutsu no nenshoshori no jitsurei). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 5(9):711-714, Sept. 1969.

The operation and efficiency of the Katayori oily waste incineration system which is in use at a chemical plant is reported. Incineration of urethane, rubber, vinyl chloride, waste solvents, rubber paste, and the like produces stack odors and toxic gas. The SP-type incinerator was designed to burn all the waste solvents such as toluol, thinners, xylol, rubber solvents, and gelled rubber refuse. The SP-type plant consists of an oily waste incineration kiln (2.5 t-3.0 t/8 hrs), annexed installations consisting of five oily waste tanks, two gearpumps, two blowers, and a conveyor. In case of liquid waste, the waste is first pressurized by a gearpump, checked by inflow control valve, and then brought into the incinerator at a fixed quantity and interval. Gelled waste is canned and put into the incinerator in batches. In this type of incinerator, the smoke and gas from the first combustion are conducted to a second incinerator and heated to 800-900 C; in a third incinerator the gas is heated to 1100-1600 C, and in a fourth incinerator it is discharged at 800- 850 C as dustless, non-toxic gas. An additional merit of the SP-type incinerator lies in utilization of surplus heat from waste gas combustion; the heat is recycled for the incineration energy source, facilitating perfect and economical combustion. The SP-type incinerator, therefore, is designed to be durable at high temperature, and all the inside fittings are fireproof.

15690

Oloman, C., F. E. Murray, and J. B. Risk

THE SELECTIVE ABSORPTION OF HYDROGEN SULFIDE FROM STACK GAS. Pulp Paper Mag. Can. (Quebec), 1969:69-74, Dec. 5, 1969. 7 refs. (Presented at 55th Annual Meeting of the Technical Section, Canadian Pulp and Paper Association, Montreal, Jan. 28-31, 1969.)

Selective absorption of hydrogen sulfide in a wet scrubber is proposed as a method of reducing the odor from kraft pulp mill recovery stack gases. A solution of sodium carbonate and bicarbonate, which is 2M in sodium, is in equilibrium with the carbon-dioxide content of the recovery stack gas and has a pH of about 9.5. The solution will selectively absorb hydrogen sulfide from the stack gas provided its sulfide content is kept low. Hydrogen sulfide absorption efficiencies of over 90% were obtained in a pilot absorption unit consisting of a packed column working in series with air sparged liquor oxidizers. The process rates indicated that an efficient absorption system for a 500 t.p.d. kraft pulp mill would require a 20-ft-diameter absorption column, with 10 ft of packing, using 3000 g.p.m. of recyling carbonate liquor. The value of the recovered chemicals was not expected to pay for the cost of recovery-gas scrubbing. (Author abstract modified)

15709

Hough, Gerald W. and Lyle J. Gross

AIR EMISSION CONTROL IN A MODERN PULP AND PAPER MILL. Am. Paper Ind., 51(2):36-37, 40-42, 44. Feb. 1969. 18 refs.

Increasing concern about the environment in the U. S. is causing federal, state, and local governments to legislate increasingly stringent laws governing emissions from industrial plants. The concepts which a pulp and paper mill can adopt to reduce emissions to levels which have been proven to be attainable are discussed. The amount of water vapor, particulate matter, and sulfur emissions in pounds per ton of pulp from each operation of the kraft pulp mill is compared before and after application of suitable controls. Air emission control systems increase both the capital and operating costs of pulp mills. Order of magnitude capital cost estimates for the air emission control equipment for a new 500 tpd pulp mill are presented.

15772

Okuno, Tosihide

THE REACTION BAD ODOR SUBSTANCES WITH OZONE. (Akushu seibun to ozon no hannosei). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 5(8):633-639, Aug. 15, 1969. 8 refs.

The removal of industrial odors by the use of ozone oxidation was studied, and their properties and behavior were described with the introduction of electron theory. Malodorous components are amine- ammoniacal compounds, lower aliphatic acidic compounds, sulfurous compounds, olefin-paraffin hydrocarbons, and other organic compounds. Olefinic hydrocarbons have a characteristic odor and a reaction mechanism for olefinic hydrocarbons and ozone was described. One of the most general reactions of the carbon-carbon double bond is an addition of ozone and rearrangement of the resultant ozonide whereby the ozonide is directly hydrolyzed by boiling with water. Secondary and tertiary amines were employed to examine reactivity and reaction products. Reactivity was determined by measuring residual ozone quantity, and reaction products were monitored by gas-chromatography. Tertiary amines reacted extensively with ozone and formed various compounds. Acrylic ester monomer, used as a raw material of acrylic acid resin, is very odorous. An oxidation experiment using acrylic ester and methacrylate was done for the removal of this odor. Acrylic ester reacted faster than methacrylate; a reaction of acrylic ester with ozone proceeded relatively fast, so this odor can most readily be removed by selecting appropriate reaction conditions. In conclusion, not all odorous components can be removed by ozone oxidation, due to the difficulty in reducing 1 ppm of malodorous components to 1 ppb (99.9% removal rate). Optimum reaction conditions and apparatus must be found for the use of ozone reaction methods on odorous sources.

15779

Collins, Theron T., Jr.

ODOR CONTROL AND HEAT RECOVERY IN WOOD PULPING PROCESS. (Assignee not given.) U. S. Pat. 3,183,145. 9p., May 11, 1965. 6 refs. (Appl. June 22, 1962, 10 claims).

Methods are described for controlling the pollution of the atmosphere and bodies of water in the vicinity of wood pulping mills. The method is described in terms of the wood pulping process; however, it may readily be adapted for use with other wood pulping processes that emit waste condensates which contain such odorous and noxious gases as methyl mercaptan and hydrogen sulfide, as well as hot water vapor laden gases which contain sulfur dioxide. The gases are passed into contact with black liquor prior to the concentration, thus oxidizing the liquor. For example, sulfur dioxide containing gases derived from the lime kiln and/or the recovery furnace are contacted with one or more of the condensates containing the sulfur compounds as hydrogen sulfide and methyl mercaptan, under conditions which cause condensation of at least a portio of the water vapor in the hot gases. A portion of the sulfur dioxide content of the hot gases reacts with a portion of the hydrogen sulfide and/or methyl mercaptan content of the condensates to render the undersirable odor producing compounds innocuous. Simultaneously, the alkaline components of the condensates are carbonated and the condensates are stripped of substantial portions of the unreacted sulfur compounds. The effluent gases are then oxidized, preferably using active chlorine containing bleach plant wastes, to oxidize the remaining odor producing materials in the gases. The condensates are cooled so as to recover a portion of their heat content and to simultaneously render the residual unstripped gases more soluble.

15948

Nakano, Toshihiro

THE EXAMPLE OF ODOR CONTROL WITH OZONE. (Akushuh taisaku to shite no ozon riyo no jissari rei: Nagoya shi Horidome shorijoh ni okeru ichi rei). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(6):359-363, June 15, 1968. 6 refs.

Deodorant and ventilation facilities at a sewer treatment plant at Horidome, Nagoya city are described. The volume of air treated is 11,910 cubic meters. The air can be changed eight times an hour, since the ducts and ventilator handle 1600 cu m per min. Because the sewer odor is a mixture of many gases, its analysis is difficult. Among the principal ingredients are hydrogen sulfide, indole, skatole, and ammonia. Deodorizing methods considered were adsorption, absorption, masking, counteraction, combustion, autotrophy, and oxidation. Because of space limitations, the method of oxidation by ozone was chosen. The amount of ozone required is about 1 ppm, i.e., 1.75 mg per cu m air. Total ozone used is 168 gr per hour. The amount of raw material is 269 liters air per min, and the rate of ozone generation is 7.6 liters per min. Four seconds are required for the mixing of odor and ozone. The reaction takes place in the exhaust duct of the ozone generator. Operating costs of the process are 104,520 yen ($290) per year. Ammonia has decreased about 60 percent. Other components can not be measured because of their low concentration. Factors affecting the continuous operation of the ozone generator will be reported later.

16113

Franzky, Ulrich

ACTIVATED CHARCOAL FILTER FOR RECLAMATION OF SOLVENT FROM THE EXHAUST AIR OF CHEMICAL (DRY) CLEANING MACHINES. (Kleinaktivkohlefilter zur Loesungsmittelrueckgewinnung aus der Abluft chemischer Reinigungsmaschinen). Text in German. Wasser Luft Betrieb, 12(3):157-161, March 1968.

Beginning January 1, 1968 all dry cleaning machines in the state of North Rhine-Westphalia must be equipped with activated charcoal filters if trichlorethylene or perchloroethylene are used as solvents. Not more than 200 mg of solvent/cu m of waste gas may be emitted. This will eliminate disagreeable odors and halve solvent consumption. The activated coal filters come in various sizes. The simplest version adsorbs 10 to 100 kg perchlorethylene. The twin version is fully automatic and has an electric steam generator. Waste air entering from the top of the unit is pressed through the activated coal. The steam passes the coal in the reverse direction, from bottom to top. The mixture of solvent and steam is condensed in the cooler. If in sufficient steam for the regeneration of the coal is available, because a dry cleaning machine is electrically heated, an electric steam generator must be installed or the entire dry cleaning machinery is switched to steam heating. The question of the most economical bag to use must be decided on an individual basis. The regeneration time is generally 20 to 40 min.

16365

Tuerkoelmez, S.

NEW METHOD OF WASTE GAS CLEANING. ELIMINATION OF ODORS THROUGH EXCHANGE ADSORPTION WITH ARTIFICIAL ION EXCHANGERS. PART II. (Neues Verfahren der Abgasreinigung. Beseitigung der Geruchbelaestigungen durch Austausch-Adsorption mittels Kunstharz- Ionenaustauschern. Teil II). Text in German. Wasser Luft Betrieb, 9(12):812-816, 1965.

Experiments in the laboratory and in a pilot plant were conducted with waste gases containing nitrogen oxides. Removal by exchange adsorption with artificial resins (such as amberlite IRA-410 and IR-45) using air or nitrogen as the carrier gas showed that the capacity of the resins was lower in the presence of air. For 1 kg nitrogen gas, 27 l amberlite IRA-410 were needed. Tests on the stability of the artificial resins by saturation in 15% nitric acid for 132 days brought positive results. Experiments with various scrubbing liquids such as water, sodium lye, and dimethylsulfoxide showed that the scrubbing process, which is actually an oxidation process, is improved by the presence of sufficient oxygen. Eleven tests with dimethylsulfoxide solution were performed. The waste gas was first cooled to 20 C and then passed over dimethylsulfoxide solution. The solution was regenerated over artificial resins which bound the HNO3 and possibly also the HNO2 through exchange adsorption. The efficiency of this method was between 80 and 98%. For regeneration of the scrubbing liquid, 300 liters of artificial resin per week were needed. The resins in turn had to be regenerated once a week with 10% sodium lye. During the experimental period, the resins suffered no decline in capacity.

16498

Heuser, A. R.

TRENDS IN AIR CONSERVATION IN THE GRAPHIC ARTS INDUSTRY. Gravure, 1969:22-25, 45-48, Feb. 1969. (Presented at the Fifth Graphic Arts Conference of the Technical Association of the Pulp and Paper Industry, Chicago, Nov. 1968.)

The main sources of pollution from processes involving printing and coating operations is exhaust from ovens and dryers. The principal contaminants are hydrocarbons from the solvents used in the inks and coatings. In addition, there can be some hydrocarbon residue from incomplete combustion of the fuel in flame dryers and ovens. Odors are also a problem, attributed to complex organic products of cracking and partial oxidation of resinous materials in solvents. In general, the solvents themselves are not responsible for odor complaints. Solvent emissions can be limited by direct-flame incineration or catalytic combustion, the latter technique being the more economical. Because of the possibility of catalyst poisoning or suppression, catalytic combustion may not meet Los Angeles air pollution regulations limiting solvent emissions to a maximum of 8% olefins and 20% toluene. Direct-flame ionization has been approved by the Los Angeles Air Pollution Control District. A newer approach to curtailing emissions from graphic art processes involves the use of inks and coatings which do not pollute air or require expensive effluent treatment. Ways by which this goal might be met are examined.

16535

Ikehata, Akira and Yasuo Kumagai

REMOVAL OF ODOR ON WASTE WATER FROM POTATO STARCH PLANT. (Bareisho denpun kojo haisui no dasshu ni tsuite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(9):575-579, Sept. 15, 1968. 10 refs.

The pollution of rivers by waste water discharged from potato starch plants is discussed. The harmful effect of the waste water is caused mainly by the so-called 'water cotton' which kills microorganisms and plankton, the staple food of fish. The waste water also creates an odor problem. The present authors studied the elimination of the odor by ozone, chlorine, and open air. Aggregation and filtration alone did not remove the odor of the waste gas, but reduced biochemical oxygen demand (BOD) by 65%, chemical oxygen demand (COD) by 68%, and chromaticity by 60%. Treatment with ozone reduced COD by 55%, chromaticity by 69%, and odor by almost 100%. Chlorine also reduced odor, though its excessive use produced chlorine odor. Treatment with open air removed most of the odor, and reduced BOD by 19%, COD by 16%, and chromaticity by 32%. Joint treatment with chlorine for 20 min and ozone for one min completely removed odor, and reduced BOD by 66%, COD by 94%, and chromaticity by 97%. Joint treatment with air for one half hr and chlorine for twenty min removed most of the odor. Joint treatment with air for one half-hr and ozone for 3 min completely removed odor, and reduced BOD by 70%, COD by 67%, and chromaticity by 76%.

16712

Bretscher, Dr. Hans

ELIMINATION OF MALODOROUS EMISSIONS IN THE CHEMICAL INDUSTRY. Chem. Engr. (London), 221:CE268-270, Sept. 1968.

Many chemical processes are accompanied by the emission of odorous substances, which may have unpleasant effects even when present in concentrations of less than 0.001 mg/N cu m. Odors are particularly difficult to deal with because: They are subjective in nature; satisfactory measurement methods are not available; and meteorological conditions affect the response to odors. As a general principle, elimination of odors at the source is the preferred method of dealing with them. A number of waste gas purification methods which are available are listed.

16747

Clement, J. L. and J. S. Elliot

NEW KRAFT RECOVERY BOILER DESIGN ELIMINATES UNPLEASANT ODOR. Paper Trade J., 153(16):63-65, April 21, 1969. 5 refs.

The use of multiple effect evaporators in place of direct-contact evaporators in kraft recovery boilers results in the elimination of most of the unpleasant odors associated with this process. In this new boiler design, unoxidized black liquor supplied directly from the multiple effect evaporator to the furnace is burned with complete combustion of malodorous compounds. A large bare tube economizer to cool combustion gases to a final stack temperature of 350 to 400 F is incorporated into the new design. Increased SO2 emission and changes in electrostatic precipitator operation are among the effects of the new design that are discussed. Well accepted in the Scandinavian countries, the new system is just being introduced into the U. S.

16807

Roberson, James E.

EFFECT OF RECOVERY ODOR CONTROL ON A KRAFT MILL ENERGY BALANCE. Paper Trade J., 153(34):86-89, August 25, 1969. 2 refs.

In the U. S., kraft pulping accounts for approximately 75 percent of the total U. S. chemical pulp production. From an air emission standpoint, odor reduction is a significant consideration in the kraft process. The energy balances associated with various odor control systems are discussed. Since each mill situation is unique, capital cost, operating cost, and acceptable emission levels must all be considered before arriving at a total evaluation of a recovery odor control system. The energy costs discussed are based on new recovery and multiple effect evaporation installations and assume that the turbine generator condenser is not operating at minimum condensing load.

16842

Walther, James E. and Herman R. Amberg

A POSITIVE AIR QUALITY CONTROL PROGRAM AT A NEW KRAFT MILL. J. Air Pollution Control Assoc., 20(1):9-18, Jan. 1970. 3 refs.

In the design of the Crown Simpson bleached kraft mill at Fairhaven, California, the latest technological developments in odor and dust control were used to design a system capable of removing in excess of 90% of the malodorous sulfur emission and more than 98% of the dust load. The odor control system consists of high-efficiency black liquor oxidation, noncondensible gas burning, and stripping of 'foul' condensate followed by burning of the off-gases. The dust control system on the recovery furnace consists of a high-efficiency electrostatic precipitator followed by wet scrubbers. The lime kiln gases are scrubbed in a Venturi scrubber and the smelt dissolver stack is equipped with demister pads. The gases from the lime kiln, power boiler, recovery furnace, and black liquor oxidizer are combined and discharged through a 310-ft. stack. A complete emission inventory has been conducted and the volume, composition, and quantity of materials discharged are presented. (Author's Abstract)

16890

Ellis, William H., Zoltan Saary, and David G. Lesnini

FORMULATION OF EXEMPT REPLACEMENTS FOR AROMATIC SOLVENTS. J. Paint Technol., 41(531):249-258, April 1969. 16 refs.

Air pollution legislation in California, in effect, requires that aromatic solvents be replaced with exempt materials. Oxygenated solvents in combination with low-aromatic hydrocarbon thinners are being used to replace the restricted aromatics. Solvency and evaporation rate are the two key performance factors that must be considered in developing replacement solvents. Cost, odor, and toxicity are also important. The use and relationship of various tools available for developing suitable aromatic replacements are described for the guidance of the formulator. Data are given for illustration. A practical approach to reformulation is outlined. (Author's Abstract)

17177

HIGH SCORE IN AIR/WATER QUALITY SET BY AMERICAN CAN KRAFT MILL. Paper Trade J., 154(11):46:53, March 16, 1970.

A 300 ton per day kraft pulp and tissue mill in Oregon is an outstanding example of the use of advanced techniques for controlling air and water pollution. Notable success has been achieved in reducing kraft odor to a barely perceptible level, and the mill is meeting Oregon's stringent air and water quality standards. The mill is distinguished from other kraft mills by the absence of a direct contact evaporator in the recovery process. Instead, a three-stage, steam heated concentrator patterned after the conventional six effect Swenson evaporator raises black liquor solids to 62-65% for burning in the recovery furnace. The effect is to eliminate one point where odor formation occurs through contact of hot gases with the black liquor. Another variation from conventional design is the use of a dry bottom electrostatic precipitator. The unit, which eliminates another point of odor formation, is rated at 99.5% efficiency. Chemical and fiber losses throughout the mill are minimized and there are safeguards from accidental spills. Sumps are located on the effluents from the paper mill, pulping and bleaching recovery, lime kiln, and causticizing. The conductivity on each sump is measured and, if the minimum chemical content is exceeded, a pump automatically returns the flow to process. To keep production at the proper levels, and for air and water quality, control instrumentation at the mill is centralized. The approximate cost of the mill's air and water quality systems is $4 million.

17238

Tanaka, Haruo, Masaru Tajimo, and Yoshinobu Takahashi

A PRACTICAL EXAMPLE OF ODOR REMOVAL AT A CHEMICAL PLANT PROCESSING FISH AND SHELLS - OXIDATION OF ODOR SUBSTANCES BY AN OZONE PROCESS. (Gyokairui kasei kojo ni okeru joshu no jissairei - ozo ni yoru yuki seibun no sanka shori). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 2(5):321-329, June 15, 1966. 10 refs.

Results obtained with an ozone odor removal process are presented. At a fish - processing plant, an odor density of 110 had been halved by elutriation with river water. The river water itself contains some odorous substance. By adding ozone to the elutriation treatment, the original odor density was restricted to less than 15. The maximum effect is achieved with 30 mg/cu m of ozone, the odor density declining even though there are some odorous substances left. If more than 30 mg/cu m ozone are used, an ozone odor is found in the emission gas. Therefore, the effective ozone supply for the original odor is thought to be 15 ppm in view of olfactory perception and atmospheric dilution. Problems associated with river water odor with respect to odor removal by elutriation can, in most cases, be resolved by the use of caustic soda, since few odorous compounds of river water are perceived by olfaction. In summer, when the pH density of the river water is higher than 5.8, neutralization by caustic soda can result in an alkaline odor remaining in the emission gas. The most ideal elutriation presented in this study indicates that 80% of the initial odor is washed by an acid liquid and the remaining 20% is purified by a weak alkaline liquid.

17266

Freyshut, Sting

PROTECTION OF NATURE IN SWEDEN -- SYSTEM AND RESEARCH. (Sueden ni okeru shizen hogo -- soshiki to kenkyu). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(1):13-17, Jan. 1970.

Several new systems developed for Swedish pulp manufacturing plants are detailed. There are some problems existing in the process of stripping, bleaching, and dehydrating solids. Moreover, the waste water from a pulp manufacturing plant contains liquid used for the raw pulp boiling process, fibrous materials, and bark from the bleaching process. The effect of a new system for reducing the amount of waste liquid is illustrated by a multiplex elutriation installation which works for both digestion and filtration. High purification efficiency is decisive in producing pulp of high quality and in this respect a new system of dispersion purification offers the following advantages: an ideal method of pure water supply, adequate time for elutriation, and sufficiently high temperature of the water used for elutriation This dispersion elutriation system is distinguished by a device that excludes outer air and foam generation to attain maximum purification efficiency. In this system, nothing but pulp is disposed to air, there are no odor problems and foaming trouble and, consequently, the initial filter water is able to be recirculated, decreasing fresh water demand for purification by perhaps 80%. This means a reversely proportional decrease of waste water inflow to the settling tank. A problem existing in a kraft plant which produced between 2 and 3 kg mercaptans and sulfuric compounds per one ton of pulp was solved by application of vapor-stripping system in which seperated sulfuric compounds and hard-to-thicken gaseous refuse are incinerated; the sulfuric compounds are oxidized by controlling incineration conditions. A cooperative system for industrial pollution involving industry and control officials is briefly outlined.

17293

Terabe, Mototsugu

BAD SMELLS AND COUNTERMEASURES FOR THE PUBLIS NUISANCE. (Akushuh to kohgai taisaku). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 5(12):696-702, Dec. 25, 1969. 17 refs.

Most malodorous substances are organic substances containing nitrogen or sulfur, such as amines and mercaptans. Other malodorous substances containing no nitrogen and sulfur are phenols, cresols, butyric acid, and valeric acid. Industrial plants which possibly emit malodorous substances process paints, metals, plastics, oils, fats, petroleum refinery, and gum. Unpleasant odors are one of the most complex public nuisances. Odors are generated by many kinds and small quantities of substances, and the only measuring apparatus is man's nose. Katz classified the intensities of smells into five classes: zero is no odor; one, barely perceptible; two, faint; three, easily noticed; four, strong; and five very strong. The relationship of this scale to ppm with several sulfur compounds was studied. The intensity of smell did not directly correspond to the density. When the density became ten times, the intensity becomes about double. The degree of odor, odor unit, odor concentration and odor emission rate were explained. G. Leonardos measured odor thresholds of 57 chemicals. Deodorization methods were classified into absorption, adsorption, chemical oxidation, combustion, and neutralization. Deodorization methods having practical utility were explained. The adsorption method using activated coal is useful for alchols, acetic acid, butyric acid, caprylic acid, benzene, and mercaptans. Adsorption efficiencies of activated coal were tabulated for 97 substances. Removal of hydrogen sulfide was studied by many methods. The Takahax wet method, absorption by naphtoquinone sulfonic acid was noteworthy. Organic substances are removed efficiently by direct gas flame incineration.

17314

Eguchi, Yoshitomo

TREATMENT OF NOXIOUS GASES BY AN ACTIVATED CHARCOAL. (Kasseitan ni yoru yugaigasu no shori). Text in Japanese. Nenryo Oyobi Nensyo (Fuel and Combustion), 36(10):937-950, Oct. 1, 1969. 10 refs.

Present investigations of gaseous atmospheric contaminants are inadequate because they are limited to gases which can be easily measured or which have an offensive musty odor. The range of contaminants is greater than assumed and increasing year after year. On frequent occasions, harmful gases contaminate the atmosphere in working and living quarters. With regard to the disposal of harmful gases by the activated charcoal method, fields of application include the elimination or recovery of organic solvents generated in chemical plants, following: prevention of emission of gasoline vapors discharged by automobiles; prevention of release of radioactive gases discharged from atomic installations, and elimination of harmful gases in indoor environments. The present status of the activated charcoal process in these fields is described and cost estimates are given.

17395

Ishikawa, Keiichi and Syunzi Otobe

ODOR REMOVAL BY METHOD OF CONTACT OXIDATION CATALYSIS, ESPECIALLY ON CATALYTIC COMBUSTION SYSTEM. (Sesshoku sankashokubaiho ni yor akushu jokyo no oyorei -- catalytic combustion system o chushin toshite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 2(7):487-489, Aug. 15, 1966.

The reliability of removing odors by contact oxidation catalysis was qualitatively determined by gas chromatographic analysis. The following conditions are imposed on the method: odorous compounds must be completely oxidized; the odor-bearing atmosphere must be mixed with a sufficient quantity of oxygen and the speed of catalysis contact must be regulated; the amount of gas can not exceed the catalytic faculty; the chemical reaction requires gas to be preheated to bring about catalysis at the right moment, combustion heat for combustible components contained in the gas should be less than 110 k cal/cu nm. Compounds reacting to a platinum-alloy catalyst are phosphorus, chlorine, lead, zinc mercury, arsenic, silicon bromine, and solid state accretions which adhere to catalyst surface. The temperature limit of the catalyst is around 650 C, the catalyst must be kept away from the flame. The catalyst facility resembles an air filter, since it is surrounded by stainless-steel frames and wire gauge and inside the frame, the activated platinum is attached to alloy ribbons for convenient handling. A platinum alloy catalyst is suitable for coasting furnaces, separate or continuous processing systems, high- pressure waste gas, over-all treatment systems, and waste incinerators. Flow diagrams presented in this paper illustrate the catalytic combustion system for each application.

17403

Hashimoto, Kiyotaka

THE POINT OF PLANNING AND ITS EFFECT ON OPERATION RESULT OF AN ELECTRIC PRECIPITATOR IN VARIOUS INDUSTRY SMOKE ABATEMENT (IX) -- TREATMENT OF EXHAUST GAS FROM REFUSE INCINERATOR. (Gyohshubetsu ni miru denkishuhjin sohchi no setsubikeikaku to untenkohka (IX) - Jinkai shohkyaku no tomonau haigasu shori ndao). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 3(9):543-548, Sept. 15, 1967. 11 refs.

Urban refuse includes many inorganic containers and vinyl bags that present difficulties with respect to perfect combustion. In Japan, the choice of incineration by equipment and incinerating schedules is left to each municipality independently; an 8 hr/day operation is common. In such cases, imperfect combustion interferes with the performance of dust collectors when they start or stop operations, and odorous waste gas emissions are inavoidable. Corrosion of the installations and damage by the heat-cycle are increased by Cl2, NH3, SO2, SO3, etc.. Consequently, a 24 hr/day operation plan with standardized equipment is advisable. For adequate combustion, O2-rich air should be used. Most recently constructed incinerators employ the following types of treatment: flow rate is controlled by a continuous dust-feeding method; dry waste gas is resolved and the odor removed through high-temperature combustion area in incinerators; temperature of the combustion waste gas is controlled, and dust removed by dry methods. Because of the wide variety of refuse in Japan, little progress has been made in standardizing incinerator operations. It is necessary to set up pretreatment installations and to improve dust removal installations.

17409

Walther, J. E. and H. R. Amberg

ODOR CONTROL IN THE KRAFT PULP INDUSTRY. Chem. Eng. Progr., 66(3):73-80, March 1970. 12 refs.

As determined by year-long odor inventories at four West Coast kraft mills, present technology will permit reduction of total sulfur compounds by 90-94%. High efficiency oxidation of black liquor should reduce sulfur emissions from the recovery furnace to about 0.1 lbs/AD ton of pulp. Emissions as low as 0.01 lbs/AD ton of pulp could be achieved by eliminating direct contact of hot flue gas and black liquor in accordance with two new systems. One system relies on concentrating the black liquor in multiple- effect evaporators to the desired concentration for direct firing to the furnace. The other systems use the hot flue gases from the recovery furnace to heat air in a laminar flow heater. This heated air is passed through a conventional cascade evaporator to raise the solids content of the black liquor coming from the multiple-effect evaporators to the concentration desired for firing in the furnace. Burning of noncondensable gases from digesters and multiple-effect evaporators in the lime kiln, recovery furnace, or incinerator is a positive method of completely eliminating this source of odors. The lime kiln can be operated at daily hydrogen sulfude emissions as low as 0.06 lbs/ton of AD pulp. Miscellaneous source odors are the washer hood vent gas, the washer filtrate seal tank gas, and the knotter hood vent gas. Although their concentration is relatively low, the volume of reduced sulfur compounds in these streams can be substantial. This area will require considerable research and development work before a completely satisfactory solution is found.

17635

Taman, Shuku, Hiroshi Muranaka, Tadabumi Tsuchida, and Hiroshi Ikeda

OFFENSIVE ODORS. 14. CHEMICAL PLANT COUNTERMEASURES IN OSAKA PREFECTURE. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 5p.

The progress of the Nishinari Health Center in promoting measures to control offensive odors from chemical plants is discussed. The area concerned is one of private houses and factories. It contains eight chemical plants: six manufacturing bone meal, oil, and fat; one, fish meal; and one, blood meal. In bone meal plants, the bones, horns, and hooves of cattle, hogs, and other animals are boiled to obtain oils, fats, and glue. The sources of odor are the exhaust fumes from the steam boiler, the glue kiln, and the exsiccation furnace. In fish meal chemical plants, the steam boiler and exsiccation furnace exhaust fumes are the sources of odor. In blood meal plants, the blood is boiled by steam to be changed into blood meal. The exhaust fumes of this steam are the odor sources. Deodorization experiments with resin were successful, but due to technical and economical problems could not be put into practice. Deodorization by adsorption was not very effective. In another experiment, the exhaust gas was cooled in a water tower and passed through an absorption vat where it was mixed with a solution of NaOH and NaClO. It was then passed through a solution of oxalic acid. This method proved to be very successful. A Committee for Solving the Chemical Plant Problem was formed to promote experimental research in deodorization methods, secure funds, and aid in construction.

17636

Takeda, Minoru, Osamu Koyama, and Tatsukichi Ishiguro

OFFENSIVE ODORS. 15. PRESENT SITUATION IN TOKYO WITH RESPECT TO OFFENSIVE ODOR CONTROL MEASURES. Taiki Osen Kenkyu (J. Japan Soc Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 4p.

The problems connected with fish refuse collected in and around Tokyo include the following: method of collection and transportation; contamination; lack of uniformity; and fluctuations in the quantity to be handled. These factors have delayed the development of proper and efficient procedures for refuse handling. The factories in Tokyo are not modernized in their processing methods. The raw materials are boiled in flat kilns, compressed by a hydraulic press, and the oil is collected. Therefore, the process was modified by using a 'cooker', by having the press and drying processes done with closed-type equipment, and by using a deodorizing device. Thus, by reducing the number of odor sources within the plant one by one, some progress in eliminating the offensive odor was made. Improvement of the present manufacturing processes is being made by using gas chromatography and other methods to investigate the constituents of offensive odors evolved from the present treatment process.

17637

Shigeno, Kenji

OFFENSIVE ODORS. 16. ELIMINATION OF OFFENSIVE ODOR OF FISH ENTRAILS AND BONES WITH BAMBOO LEAVES. Taiki Osen Kenkyu (J. Jap Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 3p.

Experiments were conducted to determine the effectiveness of bamboo leaves in eliminating the odor of fish entrails. Chopped up bamboo leaves were added to fresh cuttlefish entrails in amounts of 2% to 20%. After the mixture has been allowed to stand at 26 C, its odor was compared with that of an untreated sample. The odor of the untreated entrails was very bad, and increased after the first or second day, but the material containing 2%-5% bamboo leaves remained odorless. The odor was tested after boiling a mixture containing 2%-5% bamboo leaves, and no offensive odor was detected. Bamboo leaves were mixed with cuttlefish entrails which has been standing for seven days and were emitting a strong odor. After three to four days, the odor had almost disappeared. The composition of the leaf and other factors are being studied to determine why bamboo leaves prevent the emission of bad odor.

17906

Agnew, W. G.

AUTOMOTIVE AIR POLLUTION RESEARCH. Proc. Roy. Soc. (London), Ser. A., 307(1489):153-181, Oct. 1968. 68 refs.

Some of the progress which has been made in the United States toward the objectives of automotive air pollution research with respect to photochemical smog, carbon monoxide, polynuclear aromatic hydrocarbons, lead, and diesel smoke and odor are reviewed and discussed. Automotive air pollution research has as its objectives: (1) to understand the nature of the atmospheric effects; (2) to understand the nature of vehicle emissions; and (3) to develop concepts for the control of significant pollutants. Attempts to determine the magnitude of hydrocarbon and nitrogen oxide emissions from vehicles immediately face two severe difficulties: (1) automobiles are operated in an almost infinite variety of steady-state and transient driving conditions, ambient conditions, and states of repair; and (2) the exhaust is made up of hundreds of individual compounds with different degrees of significance and the proportions of these compounds vary with operating conditions and fuel types. The estimated contributions of the engine crankcase, exhaust, and carburetor and fuel tank to the hydrocarbon and nitrogen oxide emissions from an average uncontrolled vehicle are presented. Numerous charts and illustrations are given. Polynuclear aromatic hydrocarbons and lead in the atmosphere appear to be below the levels of any health hazards, but information in this area, as well as understanding of the vehicle emissions of these materials, is inadequate. Diesel smoke is currently a commercial economic problem requiring legal enforcement, but its odor remains a chemical mystery.

18050

Stresen-Reuter, James

CATALYTIC INCINERATOR CONTROLS HYDROCARBONS AND ODORS. Plant Eng., 23(8):142, April 17, 1969.

In the production of varnishes, vehicles and compounds for the paint industry and resins for the foundry industry, batch processing in heated, cooled, and agitated reactors, mixing tanks, and filtering equipment is used. Catalytic incineration has proven to be the most effective method for eliminating any odors from this type of process. A schematic drawing shows the control of fumes from the reactor through a spray tower to the catalytic incinerator.

18140

Hawkins, Gerald

SCRUBBER LICKS TOUGH FUME PROBLEM. Plant Eng., 23(13):70, June 26, 1969.

Air pollution control with scrubbers at Champion Papers is discussed. To eliminate the low-volume, highly concentrated sulfur-containing pollutants, two gas scrubbers were installed in parallel on two 600-ton black liquor evaporators used in the kraft pulping process. Non-condensable gases leave the surface condensers, pass through a pre-cooler, through jets, and into the gas scrubber. The scrubber's effectiveness is excellent and can easily be evaluated by observing the exhaust vents for plume evidence.

18153

Bernicchi, Robert V.

ODOR CONTROL AT TREATMENT PLANT WITHOUT MASKING. Western City Mag., 44(4):34-35, April 1968.

Abatement of odor from the sewage treatment plant of North San Mateo County is reviewed. Treatment facility odor problems could not be solved by chemical additions to sewage, but the gases emalnating had to be treated. The sources of odor were: the bar screen chamber, the sludge thickener, the sedimentation tank, the grit chamber, and the gas blow off on the primary digester. Odor from the sedimentation tank was eliminated by sealing off the tank with a concrete slab. Instead of masking the odors from the other sources, oxidation was utilized. The chemical used was Odorex, a potassium manganate compound, the chemical being automatically mixed with water and atomized over the affected area. Odors emitted by the gas blow off of the primary digester were controlled by a special scrubber unit utilizing Cataban, a compound not as effective as Odorex but capable of being regenerated and reused. Aside from odors at the treatment facility, the district had experienced problems with an inverted syphon constructed to temporarily transport sewage from a distant subdivision. The syphon emitted sulfides at a rate as high as 400 ppm. The syphon problem was solved by the addition of ferrous sulfate to the sewage being discharged into the syphon. The chemical was automatically added at the rate of 250 lbs/day.

18169

AIR WASH SYSTEMS HANDLE ODOUR FROM PACKING PLANT. Mod. Power Eng., 63(6):78-79, June 1969.

Five types of treatment were used in combination in a meat packing plant to handle odor problems from the hog plant, the oil refinery, and the acidulation plant. The five systems are: Dilution - mixing large volumes of odor-free air with air requiring dilution; single stage air-wash - all exhaust air is spray-washed with chlorine; two-stage air-wash - the second stage washes the air using clear water that adsorbs the chlorine; submerged-orifice scrubber - the air is washed in a submerged state in chlorinated water; two-stage wetted-fiber air-washing system - provides more intimate contact between chlorinated water and the air. The hog plant utilizes the two-stage air-wash with a chlorine rate of 50 ppm, the refinery unit utilizes the submerged-orifice scrubber with a chlorine rate of 50 to 100 ppm, and the acidulation odors are handled by the two-stage wetted-fiber system using a Terylene filter and clear water washing to remove chlorine.

19182

Burnett, W. E. and N. C. Dondero

CONTROL OF ODORS FROM ANIMAL WASTES. Trans. ASAE (Am. Soc. Agr. Engrs.), 13(2):221-224, 231, March-April 1970. 17 refs. (Presented at the Winter Meeting of the American Society of Agricultural Engineers, Chicago, Ill., 1968, Paper 68-909.)

A matching-standard method for the evaluation of the ability of commercial odor-control chemicals to mask or eliminate the offensive odor of an animal waste (poultry manure) when added directly to the waste in both laboratory and field tests is described. The lowest concentration of the most effective chemical can be determined. Masking agents and counteractants were the most effective odor-control products, deodorants were moderately effective, and digestive deodorants were least effective. Further research is needed on the effect of repeated applications of odor-control products on soil, so as not to harm the soil for other purposes. (Author conclusions modified)

19218

Nakajima, Shinichi

ACCIDENT PREVENTION AND COUNTERMEASURE FOR PUBLIC NUISANCE OF RECOVERY BOILER. (Kaishu boira no jiko boshi narabini kogai taisaku ni tsuite). Text in Japanese. Kami-Pa Gikyoshi (Journal of the Japanese Technical Association of the Pulp and Paper Industry), 24(7):351-355, July 1, 1970. Locomotive Manufacturing Co. (Japan).

The kraft pulp recovery boiler has more difficulties than the boiler using only heavy oil as fuel. Public nuisance is also one of the pressing problems of the day. The slight accidents that prevent continuous operation are due to corrosion of the superheated tube or leaking of the smelt. Corrosion can be avoided by using a suitable material for the wall of the tube and by maintaining a uniform wall temperature. The serious accidents accompanied by an explosion in the furnace occur through a smelting-water explosion or an explosion of the sub fuel. The former is avoided by preventing the black liquor from becoming thin and by preventing cooling water from flowing into the furnace. The latter is avoided by preventing the fire from going out. The development of a dust collector has solved the problems of smog, but offensive odor is still a problem. The principal components of the offensive odor are hydrogen sulfide and methyl mercaptan. They are emitted by the direct contact evaporator and the combustion room. Therefore, facilities without a direct contact evaporator must be established. There are two kinds of facilities without a direct contact evaporator; one has been developed in the U.S.A. and another in Scandinavia. The latter is considered to be more effective than the former. Even if the direct contact evaporator is not used, offensive odor is generated when combustion of black liquor is incomplete. The method developed by a corporation in Sweden was adopted.

19221

Tarala, Frederick E.

FILTER. (Dollinger Corp., Rochester, N. Y.) U. S. Pat. 3,513,643. 3p., May 26, 1970. 17 refs. (Appl. May 21, 1968, 2 claims).

A corrugated, porous air filter is described. The filter is a fiber glass layer secured between a relatively stiff, thermosetting layer, which resiliently retains the corrugations in place, and a pourous charcoal filter paper for removing odors from air passed through the filter. Electrical air filtering systems are expensive to manufacture and maintain. Previous mechanical systems were not efficient in removing dust, pollen, and other air-borne particulates. The filter described combines the better qualities of both electrostatic and mechanical type air filters. It can be readily assembled in a preformed housing.

19363

American Foundrymen's Society, Des Plaines, Ill.

STATEMENT OF THE PROBLEM. In: Foundry Air Pollution Control Manual. 2nd ed., 1967, Chapt. 2, p. 4-14.

Each major branch of the foundry industry - gray iron, nonferrous, malleable, and steel founding - has pollution problems peculiar to it as well as certain common difficulties. Foundry omissions are described tabularly, while pollutant sources are classified as: effluents from dust-producing operations, for which almost all foundries routinely employ some type of dust- collecting equipment; odors and gaseous compounds, most commonly from corebaking ovens; and effluents from ferrous and nonferrous furnaces. Pollutants from cupola effluent gases are described in detail and present the most complex and high-cost control problems, although there are also emissions from electric melting and duplexing furnaces, air furnaces, and open hearth furnaces. Effluents from nonferrous operations on such metals as brass, bronze, copper, aluminum, and magnesium alloys, about which less is known, are discussed. Serious air pollution exists from alloys of copper with beryllium, which is extremely toxic and requires the most efficient gas-cleaning equipment. Techniques and economics of control are discussed. The cost of dust cleaning equipment is a function of the gas volume handled, quantity and size of particulates, and temperature-corrosion considerations.

19493

Fawcett, R. L.

AIR POLLUTION POTENTIAL OF PHTHALIC ANHYDRIDE MANUFACTURE. J. Air Pollution Control Assoc., 20(7):461-465, July 1970. 13 refs.

Production of phthalic anhydride will approach 1,200,000 pounds in 1970. The process off-gas from this production consists of large volumes of air contaminated with small quantities of organic vapor and particulates and carbon monoxide. Some of the major organic contaminants in the process exhaust gas include phthalic anhydride, maleic anhydride, naphthoquione, benzoic acid, and aldehydes. A 100 million pound per year dry recovery plant will discharge from 300 to 1200 lb/hr of organics. Experience has shown that when a plant has an air pollution problem, it is one associated with nuisance odors and lachrymatory emissions. However, in certain West Coast locations, where extended periods of poor air shed ventilation exists, the problem has also been one of contribution of organics to the build-up of excessive air contaminants. Normal stack heights alone frequently have not been sufficient to prevent complaints when atmospheric conditions were not conducive to good dispersion. Plants with stacks rising to 170 ft have found that gas dispersion alone, without abatement equipment, would not consistently prevent unsatisfactory conditions from developing in the neighborhood. Today, those plants providing abatement equipment are split roughly equally between some form of water scrubbing and incineration, the latter either catalytic or direct flame. It has been suggested that by recycling a portion of the off-gases back to process, a substantial reduction in size and investment for control equipment would be realized. This scheme would only have possibilities for fixed-bed plants inasmuch as the fluid-bed units operate at or near the lower concentrations of oxygen permissable in the off-gas to effect design efficiencies for conversion to phthalic anhydride. It might be possible to reduce the off-gases from a fixed-bed plant by as much as 50%, but pilot work would be required to evaluate the effect of the contaminants in the recycle gas on catalyst life and product yields

19705

Stone, Ralph

SEWAGE TREATMENT SYSTEM ODORS AND AIR POLLUTION. J. Sanit. Eng., Div. Am. Soc. Civil Engrs., 96(SA 4):905-909, Aug. 1970. (Presented at the American Society of Civil Engineers, Water Resources Engineering Conference, Memphis, Tenn., Jan. 26-29, 1970.)

The major air pollution problem associated with sewerage systems is odor. Sludge or screening incinerators may discharge particulate matter, incompletely combusted organic compounds, nitrogen oxides, and sulfur dioxides, all of which are air pollutants. The intensity of sewage odor production is dependent upon the following factors: organic concentration, temperature, sulfate content, detention time, agitation, microbes, pH, and flow depth. Methods of odor control are: preventing the odors from forming; preventing the odors from reaching the atmosphere; and removing or renovating the odors which have been formed. Odors may be suppressed by the following methods: sewer maintenance to remove biological slimes, grease, and silt; addition of oxidation or reduction compounds; precipitation of sulfides; waste pre-treatment to reduce waste strength; and the use of perfumed masking agents. Odors can be prevented from reaching the atmosphere by sealed enclosures, and collected by a partial vacuum within the disposal facility. The odors and air pollutants such as particulate matter or nitrogen oxides can be reduced by appropriate afterburners, scrubbers, activated carbon or other specialized equipment. (Author abstract)

19850

Stormont, D. H.

REFINERS CONTINUE ATTACK ON AIR POLLUTION. Oil Gas J., vol. 58, 12p., Feb. 20, 1961.

A survey of 56 petroleum refineries was conducted to determine the extent of their control of aerial wastes from their plants. It was estimated that $12.7 million was spent in 1961 for air pollution control measures, compared with $22.5 million in

1956. The reason for this decline is that more controls are being designed into new units before they are built. The largest expenditures are for controlling hydrocarbons; sulfur compounds require the second largest outlay, followed by smoke and particulate matter, odors and fumes. Hydrocarbons are controlled by floating roof tankage or vapor recovery systems. The use of hydrogenation units to reduce the olefin content of motor fuel is another high cost control item. Almost all of the cost of sulfur compounds control is in connection with hydrogen sulfide recovery plants. Smokes have been controlled by afterburners and proper air-fuel ratios. Cyclones and electrostatic precipitators are widely used for control of particulates, with cyclones being more economical. There are several methods for controlling odors and fumes, including the separation and incineration of mercaptans and H2S from refining wastes. Benefits of air pollution control to the refinery and several research projects conducted by various plants are also discussed.

20120

Stahman, Ralph C., George D. Kittredge, and Karl J. Springer

SMOKE AND ODOR CONTROL FOR DIESEL-POWERED TRUCKS AND BUSES. SAE (Soc. Automotive Engrs.) Trans., 77(3):1657-1693, 1969. 5 refs. (Paper 680443.)

Diluted samples of exhaust from trucks powered by Cummins NH 220 four-cycle engines and buses powered by GM Detroit Diesel 6-V-71 two-cycle engines were presented to a panel of odor judges, who rated the intensity and quality of the odor in terms of reference standards. Smoke measurements were made with a PHS-designed optical smokemeter, and experiments were conducted to measure the effectiveness of a variety of control techniques. Although smoke emissions from the buses were substantially lower than from trucks, the buses presented a worse odor problem. Fumigation systems which meter a small amount of fuel into the intake manifold of the engine to initiate precombustion reactions before and during the compression stroke decreased exhaust smoke from both engines but only at low engine speeds. Significant smoke reductions occurred when air was injected as close as possible to each exhaust valve of a four-cycle engine, probably due to oxidation of the carbon particles; but no beneficial effects were observed when this system was investigated with a two-cycle engine powered bus. Engine derating was attributed to reduced emissions of two over-the-road tractors, although a third tractor exhibited very low baseline smoke characteristics, and tests with a 5 truck fleet using a single commercial fuel additive confirmed significantly reduced smoke levels. The Jacobs Engine Brake showed no promise in reducing smoke and odor, while two types of catalytic mufflers showed significant influence on odor levels.

20258

Brink, David L., Jerome F. Thomas, and Kay H. Jones

MALODOROUS PRODUCTS FROM THE COMBUSTION OF KRAFT BLACK LIQUOR. III. A RATIONALE FOR CONTROLLING ODORS. Tappi, 53(5):837-843, May 1970. 12 refs. (Presented, in part, at the Technical Association of the Pulp and Paper Industry, Annual Meeting, New York, Feb. 1967.)

Studies of batch and steady-state pyrolysis in kraft black liquor combustion are summarized and pertinent differences are discussed in a series of experiments covering a temperature range from 400 to 1135 C. A many-fold increase in the volume of uncondensed gases formed in the higher temperature ranges, and the composition of these gases, are presented as evidence for the occurrence of extensive gasification of carbonaceous residues by the steam-char reaction under steady-state conditions. This reaction is significantly reduced under batch conditions. In the lower temperature ranges, a high percentage of the sulfur present in the black liquor is converted to an array of at least 57 different sulfur-containing malodorous products. Under steady-state conditions, these products are decomposed as temperature is increased with only small amounts remaining above 1000 C. A summation of the calorific values of the major steady- state pyrolysis products isolated from black liquor solids shows the overall system to be endothermic. The significance of the study with respect to furnace operation and associated problems, especially odor emission and its abatement, are discussed, and a conceptual basis for designing a pyrolysis-combustion system employing multistage pyrolysis is suggested.

20369

Rothe, Wilfried

PROCESS FOR DESULFURIZING AND DEODORIZING HYDROCARBONS, ESPECIALLY HYDROCARBON OILS. (Deutsche Gold- und Silber-Scheideanstalt vormals Roessler (West Germany)) U. S. Pat. 3,496,098. 2p., Feb. 17, 1970. 4 refs. (Appl. Feb. 23, 1967, 5 claims).

Carriers which improve the desulfurizing and deodorizing action of sodium compounds used to treat hydrocarbon vapors are presented. The carriers are mixtures of carbon, preferably graphite, and an alkaline earth metal, preferably calcium oxide; the ratio of oxide to carbon is between 1:0.2 and 1:5 by weight. The carriers are intimately mixed with sodium monoxide or sodium hydride in the form of spheres, cylinders, tablets, and the like by compression molding or extrusion. Because the desulfurizing composition has high heat conductivity, heat accumulations in the reactor bed are avoided and the ability of the alkaline earth metal oxide to absorb sulfur is fully utilized. In addition, the desulfurizing compositions do not sinter during the reaction condition to such an extent that they are impermeable to the hydrocarbon vapors. The hydrocarbons to be purified are passed over the catalysts at 150 to 300 C, whereby all types of organic sulfur compounds are removed.

20625

Tsuiji, M., T. Okuno and T. Yamamoto

STUDIES ON ODOR ADSORBING ABILITY OF ADSORBENTS AND THEIR APPLICATION TO ODOR SOURCES. PART II. (Kyuchakuzai ni yoru akush no johoritsu oyobi hasseigen ni okeru riyoho no kento (II). Text Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):71, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.)

The continuous flow of odorous gas through the adsorbent tower reduces the effectiveness of the adsorbent until the equilibrium state is attained. It is then necessary to exchange the adsorbents or to reactivate them. The change in the amount of adsorption due to temperature of reactivation and the frequency of reactivation was studied. The change in the surface structure of the adsorbent during gas release due to reactivation heating was investigated. In order to confirm that during heating, the released gas reacts with oxygen in air and the adsorbent surface, the resulting gas was analyzed. The adsorbents used were vegetable-type activated charcoal, sulfonated coal, and MGP. The odorous gases were hydrogen sulfide, mercaptan, ammonia, methylamine, dimethylamine, and trimethylamine.

20628

Odaira, T., J. Kazumi, K. Koyama, and T. Ishiguro

CONTROL ON ODOR OF FISH MEAL PLANTS IN DRYER EXHAUST. (Gyochokotsu shori kojo no kansoki haikigasu dasshushori ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):72, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.)

Among the nuisance complaints to the Tokyo Metropolitan Government, 20% concern obnoxious odors. One of the main sources is considered to be the fish meal plants. A study was conducted on how odors can be removed within the existing production framework. The main sources are the exhausts from the dryers and the liquids produced by pressing fish parts. Limiting the scope to exhausts, the following control methods were tested: ozone oxidation, chemical purification, and absorption; the block diagram for each process is presented. The tabulated results show that each control method, the rate of odor removal was 60 -80%. Although the percentage is tolerable for ordinary dust particles, it is not enough for bad odors and further improvement is necessary.

20709

Sato, S.

DISPOSAL OF ODOR IN FERTILIZER INDUSTRIES. (Keifun kansokojo no akushugasu no shori ni tsuite). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):73, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.)

The exhaust gas from the dryer for fertilizer manufacturing in a chicken farm is a severe pollution problem due to its extremely obnoxious odor. Most dryers fall into the rotary kiln category, to which the discussion is limited. Among various ways of removing the odor, for a farm with the capacity less than ten thousand chickens, the process of passing the gas through earth, particularly from agricultural land, is effective, apparently due to the action of bacteria and physical adsorption. For larger farms, the purification method using alkali solution is more useful, and the process was actually employed in a farm with three dryers, each with a capacity for ten thousand chickens. A nearby stream of pH 3-4 was used with 1% alkali solution in order to eliminate the odor and was found to be very effective.

20754

Kline, Millard F.

RETAINER FOR PURIFICATION MEDIA FOR GAS FROM SEWER LINE VENTS. (Assignee not given.) U. S. Pat. 3,475,885. 4p., Nov. 4, 1969. 15 refs. (Appl. May 2, 1968, 2 claims).

Building sewage systems are usually provided with vent pipes which extend vertically through the roof and through which germs and other impurities can pass. In densely populated areas, a significant amount of polluting agents are this emitted to the atmosphere. However, the often inaccessible location of the vent pipes has discouraged utilization of filtration means. A solution to these problems is offered by a three-part retainer which is adaptable to conventional pipes. The three parts are a cap, a cup-shaped container, and baffle means which includes an annular space filled with activated charcoal filters or a liquid cleaner-germicide-deodorizer. The annular space is disposed around the existing vent pipes so that the entire purifying medium is utilized without a portion of it becoming stale and ineffective while other portions go largely unused. The design facilitates replacement of the purifying medium. Moreover, the purifying element is so located that undue back pressure is not created in the vent pipe to adversely affect its ventilating function.

20796

Turk, Amos

INDUSTRIAL ODOR CONTROL. Chem. Eng. Deskbook, 77(9):199-206, April 27, 1970. 13 refs.

Accepted methods of odor control are examined with special emphasis on what can go wrong in the methods themselves or in assumptions of the degree of control thought to be necessary. Odors are extremely difficult to measure, and it is equally difficult to decide what levels are accepted. Distance from a source at which odor may be detected is not predicted even approximately from dilution ratios and dispersion calculations. Meteorological dispersion formulae give little help in estimating the ratio of peak to mean concentration, since the parameters they incorporate are to a large extent empirical and are well established only for prolonged release and average plumes. Particles may contribute to odor if they are volatile, if they release adsorbed odorous vapors, or they are indeed odorous in themselves. Thus, if a single particle carries odor, it constitutes transport with dilution. Complete oxidation of odorous vapors eliminates their odors, but when oxidation is incomplete, the odor quality may actually get worse before it gets better. Catalyst deterioration, selection of temperature and residence time, and comparison with solvent recovery are some of the main problems in air oxidation to which the engineer should be alert. Other oxidizing agents used for deodorization include ozone, chlorine, chlorine dioxide, hypochlorites and permanganates, but the question of odors of intermediates may be critical. Activated carbon is the only practical adsorbent that can be used for odor control because its performance is not weakened by the presence of moisture, but there are problems of catalytic action, rapid saturation from spills and vapor surges and special reactivation methods. The vapor screen or neutralization concept consists of interposing a vertical wall of odor-neutralizing vapor between the odor source and the sensitive noses of neighborhood residents. Washing and scrubbing, counteraction and masking are also considered.

20817

Walker, Alan B. and Norman W. Frisch

SCRUBBING AIR. Sci. Technol., no. 95:18-21, 24-27, Nov.-Dec. 1969.

Several devices and methods for controlling air pollution are discussed. The simplest particulate collector is the dry inertial or mechanical type of which the most common is the cyclone. Mechanical collectors are applied where the particulates are coarse, high efficiency is not required, and concentrations of entrained particles are high. Less simple and more costly are the wet, inertial scrubbers which can collect droplets and particulates. There are many types, all operating on the principle of impaction on wetted surfaces or on individual droplets of the scrubbing liquid. Most filtration methods to remove particles from a gas use fabric filters. The most highly developed are fabric bags inflated with the gas to be cleaned. The electrostatic precipitator is unique because it applies its cleaning action only to the particulates, and its power input requirement is thus very low. It is suited for very large gas volumes, and can collect particles down to sub-micron size with high efficiency. Flame afterburners can remove combustible aerosols and gases, eliminate toxic or odorous compounds and the danger of explosions, with efficiencies of 90% or more. A tall chimney is also an air pollution device, because some pollutants, when released in the air, are acted upon by natural processes that convert them to relatively harmless substances. Adsorption and absorption are also discussed, and the costs of these methods are given.

20824

Yocom, John E. and Richard A. Duffee

CONTROLLING INDUSTRIAL ODORS. Chem. Eng., 77(13):160-168, June 15, 1970. 22 refs.

Various methods for controlling odors from industrial sources are discussed. Odorous emissions can be reduced by controlling the process temperature, pressure, ventilation, and maintenance. Destruction by flame is the most certain and most flexible method of odor control. Afterburners have been applied to many processes. A temperature of 1200 F in the presence of excess air is needed to completely destroy odors. Combustion with air on catalyst surfaces reaches completion at lower temperatures and is flameless. It has many limitations, however, and should be applied only after pilot tests. Many organic gases are converted to odorless compounds by chemical oxidation using oxidants such as chlorine, chlorine dioxide, ozone, or potassium permanganate. Many odorants can exist as liquids under ambients conditions; cooling such vapors can remove much of the odor by simple condensation. Absorption is used to remove soluble inorganic gases such as hydrogen chloride and ammonia. Organic gases and vapors can be removed from air streams by adsorption with activated carbon. Many odors can be controlled by dilution at the source of emission. The costs of these various control methods are also discussed.

20877

Springer, Karl J.

AN INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE. (PART II). Southwest Research Inst., San Antonio, Tex., Vehicle Emissions Research Lab., NAPCA Contract PH 86-67-72, Rept. 11-2056-01, 634p., Feb. 1968. 19 refs.

A ten-person odor panel, trained in the characterization of dilute diesel exhaust samples according to the PHS quality/intensity rating kit and the PHS light-extinction smokemeter, were used to measure odor and smoke. Evaluation of several two-cycle powered municipal buses equipped with automotive type catalytic devices revealed that one device noticeably reduced exhaust odor and other emissions such as formaldehyde, total aldehydes, and acrolein, but had no positive effect on smoke. The smoke suppressing ability of a barium diesel fuel additive was successfully demonstrated in a five-truck fleet. Power rating had a pronounced effect on visible smoke output, although it appeared to have little or no effect on perceived odor, when engine derating was investigated with a Cummins NH-220, GM 6-71 N and a Mack END-673P. A limited study of the effect of injecting air in the exhaust at the underside of exhaust valves of a two-cycle powered municipal bus had a negligible effect, while a brief evaluation of the Jacobs engine brake also resulted in no noticeable change. Special studies were conducted and reported, including the effect of exhaust pipe size on smoke readings, preliminary studies of a tentative PHS smoke procedure, attempted evaluation of an electrostatic precipitator, and base line odor, smoke, and emissions from a municipal coach powered by a four-cycle V8 engine. (Author abstract modified)

20878

Springer, Karl J.

AN INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE (PART III). Southwest Research Inst., San Antonio, Tex., Vehicle Emissions Research Lab., NAPCA Contract PH 22-68-23, Rept. 11- 2600, 766p., Oct. 1969. 12 refs.

A ten-person odor panel, trained in the characterization of dilute diesel exhaust samples according to the PHS quality/intensity rating kit and the PHS light-extinction smokemeter, were used to measure odor and smoke. A commercially available diesel fuel odor additive had no effect on perceived odor from three two-cycle Detroit Diesel 6V-71 E powered municipal buses, and inconsistent reductions in odor generally resulted from a catalytic muffler device, although certain of the chemical emissions such as hydrocarbons and carbon monoxide were generally always reduced. Both odor and smoke were less from similar buses powered by a 6V-71 N type engine. A number of truck-tractors with a variety of engines and drivelines were evaluated to develop dynamometer procedures and acquire limited baseline emissions. Due to low exhaust temperature and unsteady flow conditions with extended engine idle, the city bus exhaust represents one of the most difficult to treat by catalysis, and a number of catalytic devices employing both transition metal and precious metal catalyst coatings were unsatisfactory. An electrostatic precipitator was completely unsuccessful in reducing smoke according to the smokemeter, while fuel seemed to have little or no effect on perceived odor from three buses powered by 8V-71 N engines. A modified needle type or 'N' injector resulted in lower smoke, odor, and other emissions such as HC, CO, and acrolein under all conditions investigated. Correlation studies were undertaken to develop an instrumental technique to extend the usefulness of the trained odor panel, including the measurement of total hydrocarbons, carbon monoxide, carbon dioxide, nitric oxide, nitrogen dioxide and total aldehydes, formaldehyde and acrolein.

21006

Burt, Leslie R.

AIR TREATMENT. (Hexatron, Inc., Arcadia, Calif.) U. S. Pat. 3,486,308. 5p., Dec. 30, 1969. 21 refs. (Appl. Jan. 2, 1968, 1 claim).

An air treatment device is described which is capable of removing obnoxious odors from the air, collecting bacteria for test purposes, and generating negative ions to promote the comfort and health of patients. The exterior housing has apparatus for filtering particulate matter, such as dust and pollen from air flowing through an inlet opening. An ultraviolet lamp is located within the interior housing and generates radiation having a wave length above 1800 A for sterilizing and negatively ionizing the air. A blower is provided, causing the air to flow through the filter apparatus and the interior housing, while a plurality of baffles increases the path length of the air flow to longer than the length of the interior housing, thereby exposing the air flowing through to the ultraviolet radiation for greater periods of time. The surfaces of the interior housing and of the baffles are provided with a reflective finish, thus increasing the effects of the ultraviolet radiation. Growth medium may be supported within the interior housing to collect bacteria from the air passing through. Switch apparatus is provided to turn off the untraviolet lamp so that the bacteria are not killed during the sampling process, until after they are grown when they may be killed by redirecting the radiation. (Author abstract modified)

21051

Roberson, James E.

THE EFFECT OF ODOR CONTROL ON A KRAFT MILL ENERGY BALANCE. J. Air Pollution Control Assoc., 20(6):373-376, June 1970. 3 refs.

Thirteen different recovery unit odor control cases are analyzed to determine the variation in energy costs for a kraft mill. Incineration or scrubbing is often used to reduce odors, except for the recovery unit which is the greatest offender. Oxidation or removal of the direct contact evaporator appears to be the most reasonable method of reducing the odorous emissions of hydrogen sulfide. New recovery systems, which eliminate the direct contact of flue gas and black liquor, have several variables that affect energy costs: steam coil air heaters, recirculating air heaters, regenerative air heaters, 55% to 60% solid evaporators, and large economizers. These variations are calculated and presented as energy balances, indicating that engery costs for various odor control systems are of sufficient value to be considered during evaluations. The newer recovery systems have the lowest expected fuel cost as well as significant chemical cost savings. Capital costs, fuel costs, and acceptable emmission levels should all be considered before arriving at a total odor control system evaluation.

21220

Rutherford, J. G.

ENVIRONMENTAL CONTROL AT INCO UNDERGROUND DIESEL OPERATIONS. Can. Mining J., 89(10):54-58, Oct. 1968.

The 88 diesel-powered engines in service at 10 underground mines in Sudbury, Ontario, include load-haul machines, locomotives, drill jumbos, secondary drill tractors, service tractors, and a jeep. The methods employed to ensure proper engine fuel-to-air ratios, to eliminate toxic combustion products, and to provide adequate ventilation in diesel operating areas are described. To maintain clean burning engines, the oil in each intake air cleaner is periodically changed on site and the entire cleaner unit is completely cleaned once every two or three months. Oxy-catalytic scrubbers on diesel engine exhaust convert approximately 96% of the carbon monoxide to carbon dioxide. Similarly, hydrogen is converted to water vapor; aldehydes are almost completely removed; solid carbon, tars, and unburnt oil are oxidized to carbon dioxide, thus eliminating the smoke and smell associated with internal combustion engines. Since nitrogen dioxide is not affected by the oxidation process, adequate ventilation is required to dilute and ventilate this gas. Special mechanical ventilation systems are provided at all disel development operations and at all ore extraction operations not directly ventilated by a main surface fan. Both electric and compressed-air fans are used for auxiliary ventilation. These procedures are augmented by weekly tests and volume surveys at each machine.

21294

Bauch, Heinrich and Harry Burchard

ATTEMPTS FOR IMPROVING STRONGLY SMELLING OR TOXIC EFFLUENTS BY OZONE. (Ueber Versuche, stark riechende oder schaedliche Abwaesser mit Ozon zu verbessern). Text in German. Wasser Luft Betrieb, 14(4):134-137, 1970.

The influence of ozone on waste water from the lacquer and paint industry containing alcohols, esters, ketones, aldehydes, benzene, xylol, toluol, phenols, thioesters, chlorinated hydrocarbons, fats, and oils was studied. The waste water was subjected to preliminary treatment. The pH was reduced to between 2 and 4 with sulfuric acid; 0.05 to 0.1 g iron and/or aluminum was added. Calcium hydroxide was added until a pH of 6.5 to 8 was obtained. Most metals, organic solvents, oils, and resins were removed. The phenols, esters, alcohols, etc. were not affected by this treatment. Addition of ozone (ozonized air, or ozonized oxygen) markedly diminished the KMnO4 demand. Odors were strikingly reduced. But not all organic substances were oxidized. Acids, chlorinated hydrocarbons, pyridine, and saturated paraffins were hardly attacked by ozone. Preliminary treatment of the waste water with chlorine reduced the ozone consumption.

21647

NIPPON KOKKAN KK-KOKO MODEL. BROCHURE DESCRIBING AMMONIA SCRUBBING PILOT PLANT. Translated from Japanese. Belov and Associates, Denver, Colo., 4p., April 22, 1970.

A pilot installation is described which simultaneously controls a very high percentage of emissions of dust particles and 90 to 95% of sulfurous acid gas. The apparatus embodies a wet-type, atmospheric vapor exchange method, in which liquid is poured through an anti-corrosive synthetic net and spreads out to form a film, through which the gases pass with a special contact mechanism. With very little pressure loss, nearly insoluble gases are effectively absorbed. Gas that has been inducted into the tower cannot leave without contacting the treated solution, and since it makes contact repeatedly, the gas absorption rate is greatly improved. Because pressure losses are small, the cost of running the gas conduction blower is reduced. Flexibility, ease of operation, and maintenance are improved, and recovery of valuable particulates from the gas stream is facilitated. Applications include use in boilers, high temperature furnaces, control of sulfurous gas from oil-burning fuel systems, odor counteraction, and gas recovery and heat exchange in the chemical and oil industries.

21677

OFFENSIVE ODOURS FROM MEAT PACKING PLANT ELIMINATED IN TWO STAGE AIR WASHING SYSTEMS. Mod. Power Eng., 64(6):78-79, June 1970.

Air pollution in meat packing plants comes mainly from the odors created in the processing of animal carcasses and in the refining of oils. A system to control offensive odors is described. The system involves washing the odorous air with chlorine-treated water in a two-stage process. Individual treatment of different odors produced is accomplished through different types of air washes for the stronger odors, and with air make-up units for dilution of the weaker ones. A classification of the types of odors produced is included, as well as other possible treatment methods. The system described is almost 100% successful in eliminating odors, and is used as a model for other odor control systems.

21702

Sponsel, Kurt

FILTER FOR CLEANING GASES, VAPORS AND AIR. (Filter zur Reinigung von Gasen, Daempfen und Luft). Text in German. (Collo Rheincollodium Koeln GmbH, Bonn (West Germany), Werk Hersel) Swiss Pat. 450 816. 2p. Jan. 31, 1968. (Appl. Sept. 11, 1963, 7 claims).

A filter was devised for cleaning waste gases, vapors and air, which consists of an organic, hydrophilic open-cell foam matrix containing a catalyst. A redox system containing metal oxides is preferably used as catalyst, but other organic compounds such as enzymes and fermentations can be used too. The catalysts are incorporated on linear or meshed polyurethane foam. If the filter is used to clean the waste gases of combustion engines, phenolic resin can be used as matrix material. It is advantageous to add an emulsifier to the foam mass. If the filter is used for deodorizing waste gases, the foam mass should contain montmorillonite which adsorbs proteins and their decomposition products, while prolonging the activity of the filter.

21883

Bernert, J.

EXPERIMENTS CONCERNING ODOR ELIMINATION AT FOOD OPERATIONS. (Versuche ueber Geruchsbeseitigung in der Lebensmittelproduktion). Text in German. VDI (Ver. Deut. Ingr.) Ber., no. 149:303-312, 1970. 20 refs.

The efficiency of waste gas cleaning systems at various food operations was determined by a silica gel method. Treatment in a flame afterburner of the waste gases developing during hot-curing of meat reduced the C-content from a maximum of more than 300 mg/cu Nm to 150 mg/cu Nm. At the cold-smoking process, C-concentrations of less than 100 mg/cu Nm were achieved. Efficiencies as high as 97% were achieved with a combination of flame afterburners and cyclones in the production of malt and separation of husks at a brewery. Pressure jump condensers installed in beer breweries were found to precipitate 32.5% of the condensate and 36.5% of the C-content after a temperature drop of 3.8 C (from 88.8 C to 85 C). It is indicated that greater temperature drops would bring even better efficiencies. At a protein dissociation phase in spice production plants, microorganisms are used for biologic decomposition of the harmful and/or odorous gaseous components. The efficiency of this cleaning method was found to reach 75.7%, but the above method was not suitable for determining the efficiency of an air filter installed in a meat canning plant. It is estimated, however, that their efficiency amounts to about 80%.

21938

Goldfield, Joseph, Vincent Greco, and Kumud Gandhi

GLASS FIBER MATS TO REDUCE EFFLUENTS FROM INDUSTRIAL PROCESSES. J. Air Pollution Control Assoc., 20(7):466-469, July 1970.

Many effluents from process operations produce submicron, organic, sticky particulates that are difficult to filter. They may be associated with odors. Until now, incineration or high energy scrubbers operating at as high as 60-70 in. of water were among the possible air cleaners that could solve these problems. The operating costs and the possible water pollution problems make it desirable to find alternative solutions. Effluents from glass fiber ovens and forming chambers and from roofing plant saturators are filtered. Samples are drawn from the stacks of these machines through samples of glass fiber mats of various fiber diameters and through relatively coarse fiber mats impregnated with asbestos fibers. Efficiencies are measured by a Sinclair-Phoenix photometer, gravimetrically, and by odor tests. In the ranges tested, efficiency appeared to increase with increasing velocity through the mats. At velocities of 500-700 ft/min through the glass fiber mats, efficiencies of well over 90% are not uncommon. Pressure drops are 16-18 in. water. Odor tests show that odor reduction correlates with particulate removal, indicating that most of the odor is due to particulates. The useful life of the filter depends on the degree of plugging. For the effluents tested, two to three hours is practical and economically feasible. A full-scale installation of 10,000-11,000 cfm capacity has been made and is operating successfully. (Author abstract)

22061

Akamatsu, K.

OZONE OXIDATION OF DIMETHYL SULFIDE AND DEODORIZING OF KP BLOW-GAS. (Jimechiru sarufaido no ozonsanka to KP burogasu no mushuka ni tsuite). Text in Japanese. Kami-pa Gikyoshi (J. Japan. Tech. Assoc. Pulp Paper Ind.), 22(4):200-204, April, 1968. 7 refs.

The main cause of obnoxious odor from kraft pulping (KP) is in the sulfur compounds that arise in the process. Sulfur compounds in reduced form are odoriferous whereas those in oxidized form are either odorless or just irritants. Tables are presented on the amount of dimethyl sulfide (DMS) that can be retrieved from KP black liquor at various temperatures and with different amounts of Na2S added. Different quantities of organosulfur compounds released in KP of different types of trees are listed for various pulping conditions. In general, the broad-leaved trees yield more odorant substances than do the coniferous trees. The data were obtained by a process similar to the theoretical method, and the quantity of organosulfur compounds from real KP process is probably much smaller. The gaseous sulfur loss balance sheet for two factories in the South (U. S.) show that most of the sulfur released is in the H2S emitted from the recovery furnace, followed by sulfur dioxide gas and DMS. A brief description of a process for deodorizing DMS by ozone oxidation is given. However, unless inexpensive methods are found for the production of ozone, the method is still far from application.

22353

Mitchell, G. E.

ENVIRONMENTAL PROTECTION-BENICIA REFINERY. American Petroleum Inst., New York, Div. of Refining, Proc. Am. Petrol. Inst., Sect. III, vol. 50:638-650, 1970. (Presented at the American Petroleum Institute, Division of Refining, Midyear Meeting, 35th, Houston, Tex., May 13-15, 1970.)

Protection of the environment was a basic concept in the design of the Benicia Refinery. From the inception of the project, plans were included to provide the equipment needed to maintain air, water, and noise level standards which conform with best practices. The refinery is designed to meet the stringent air and waste water quality standards prescribed by regulatory agencies in the San Francisco Bay Area. As part of the program to define the performance and equipment requirements to meet these quality commitments, an extensive survey of environmental conditions at the site was made before starting construction. The abatement systems that were installed have resulted in air and waste water qualities that have been generally satisfactory. Particulate emissions are controlled by cyclones and an electrostatic precipitator. Plume opacity does not exceed Ringelmann No. 2 for more than three minutes out of every hour. Sulfur dioxide concentrations are minimized by Claus process recovery units. Hydrocarbon emissions are restricted by vapor recovery systems. Odors originating from sulfur compounds are treated satisfactorily. Stacks are high enough to allow stack gases to disperse easily. The low refinery water usage along with the need to handle relatively large amounts of sour water has complicated the waste water treating operations. Some equipment changes are planned to improve the treating. Careful attention was given in the design and equipment procurement stages to minimizing noise levels to protect conditions in the community and also to avoid adverse effects on plant personnel. A few relatively minor deficiencies found after startup were corrected by equipment modifications. (Author abstract modified)

22357

Fernandes, J. H.

ELIMINATION OF ODORS AND DUSTS CREATED BY THE COMMUNITY AND BY INDUSTRY. (L'eliminazione degli odori e delle polveri provocate da comunita e industrie). Text in Italian. Inquinamento, 12(3):27-35, 1970.

The various processes are reviewed by which odors and dust particles in the atmosphere can be reduced or eliminated. Reference is made to an extensive series of studies by the Air Preheater Company, which has developed an odor-eliminating device known as Cor-Pak, which eliminates disagreeable vapors by burning them in a flame. Odors can also be reduced by wet processes and by oxidation with a catalyst. Special attention is given to the elimination of odors from a paper mill and from incinerators where solid waste is burned. Included in the discussion of dust removal is a discussion of cyclones, scrubbers, electrostatic precipitators and the various types of filters. Cyclones are effective with dust particles of 20 micron or larger. Electrostatic precipitators require a voltage of 50,000-100,000 V. On the other hand, the pressure drop is only about 2.5 12 cm H2O, and the dust collecting efficiency is better than 99%. Particles of less than 1 micron are captured just about as readily as those 100 micron in size. Although bag filters are highly efficient (99.9% dust removal), the cost of installation and of replacing the bags is a serious drawback to their extensive use.

22400

Vedernikov, V. G. and V. F. Maksimov

SOME PROBLEMS IN THE DEODORIZATION OF GAS DISCHARGES IN THE SULFATE-CELLULOSE INDUSTRY. (Nekotorye voprosy dezodoratsii gazovykh vybrosov sul'fatno-tsellyuloznogo proizvodstva). Tr. Tsellyul. Bum. Prom., vol. 13:148-154, 1964. 10 refs. Translated from Russian. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 13p., Nov. 11, 1969.

The use of uncondensed exhaust gases as a deodorizing agent in the sulfate-cellulose industry is discussed. Mercaptan and hydrogen sulfide trapping methods are described. A sulfane production system which employs condensation, scrubbing, absorption, and a methanol bath is considered. Experiments with black liquor oxidation are conducted in an attempt to solve deodorizing problems. The industrial method of obtaining dimethylsulfoxide from the toxic sulfur-containing discharge dimethylsulfide is discussed. Gases uncondensed by water discharged by the digestion works must be combined and directed into an absorption chamber. On evaporation of black alkalies, H2S and methyl mercaptan are isolated as a consequence of the hydrolysis of sodium sulfide and sodium mercaptide contained in the black alkali. Deodorization in the soda section with an electrofilter and a scrubber is feasible, but requires corrosion resistant conduit.

22435

Mallatt, R. C., J. F. Grutsch, and H. E. Simons

TERTIARY TREATMENT AND FLUIDIZED BED INCINERATION AT AMERICAN OIL COMPANY. American Petroleum Inst., New York, Div. of Refining, Proc. Am. Petrol. Inst., Sect. III, vol. 50:651-669, 1970. (Presented at the American Petroleum Institute, Division of Refining, Midyear Meeting, 35th, Houston, Tex., May 13-15, 1970.)

American Oil Company has carried out pilot plant work on two combination treatment sequences which reduce oil, BOD, suspended solids, taste and odor contributing substances, and other impurities in spent process water to levels normally associated with tertiary treatment. This has been accomplished by treating effluent from the company's patented Bio-Flotation process with alum and polyelectrolytes to coagulate the residual contaminants, followed by phase separation using either the air flotation process or mixed media filtration. Commercial facilities have been constructed at American's Whiting, Indiana, refinery and are presently being evaluated. Present plans call for disposal of sludges in a fluidized bed incinerator, based upon successful operation of a prototype unit at the company's Mandan, North Dakota refinery. (Author abstract)

22518

Paulson, E. G.

ADSORPTION AS A TREATMENT OF REFINERY EFFLUENT. American Petroleum Inst., New York, Div. of Refining, Proc. Am. Petrol. Inst. III, vol. 50:693-722, 1970. (Presented at the American Petroleum Institute, Division of Refining, Midyear Meeting, 35th, Houston, Tex., May 13-15, 1970.)

An investigation to determine the technical and economical feasibility of treating refinery effluents by means of the granular activated carbon waste treatment is presented. Data show that granular activated carbon treatment can produce a refinery effluent containing less than 20 mg/l BOd and less than 10 units of Recognition Odor Number (RON) from either primary or secondary refinery effluents. Evidence that those organic compounds contributing to odor are preferentially adsorbed relative to total mixture of organic contaminants is also shown. In addition, necessary pretreatment requirements to effect suspended solids reduction below 60 mg/l and oil less than 20 mg/l prior to carbon treatment are described. Capital cost estimates for 1, 5 and 10 MGD plants are given. B6reeakdowns include estimates for clarification and adsorption/reactivation systems. (Author abstract modified)

22522

NOW...RECOVERY BOILERS CONTROL ODOURS. Mod. Power Eng., 64(7): 50-53, July 1970.

A recovery boiler which controls the odors emitted by a kraft pulping plant is described. The new type of unit features a design eliminating any contact between odor bearing black liquor and cool stack gases, preventing the escape of odors to the atmosphere and minimizing the odor problems associated with conventional black liquor chemical and heat recovery boilers. The new boiler design uses multiple-effect evaporators to concentrate the liquor to 65% solids, suitable for direct firing in the boiler. Heat recovered by the direct-contact evaporator in conventional designs is recovered by an enlarged economizer section. The new units use a wall spraying technique of liquor firing to provide stable furnace combustion over a wide range of liquor concentrations. Liquor drying is achieved by secondary air. Air admitted to the hearth burns liquor char, reduces sulfates to sulfides, and smelts chemicals for recovery. Gases discharged from the unit can be controlled to less than 1 ppm hydrogen sulfide. Elimination of the direct-contact evaporator causes changes in the electrostatic precipitator design. The precipitator must have an increased efficiency to maintain the weight of sodium sulfate fume passing up the stack at the same level that could be achieved with conventional designs. The units will discharge more sulfur dioxide to the atmosphere, but it is expected to be below 500 ppm.

22525

Heller, Arnold

MEASURES DESIGNED TO REMOVE ODOR GENERATED BY A COCOA PROCESSING PLANT. (Massnahmen zur Beseitigung von durch Kakaowerke bedingte Geruchsbelaestigungen). Text in German. Schriftenreihe Ver. Wasser Boden Lufthyg. (Berlin), no. 33:57-60, 1970.

The roasting of cocoa beans at 130 C generates a characteristic sweet pungent roasting odor, the processing of the roasted beans liberates tannic acid, and finally cocoa butter emits a not unpleasant but in the long run offensive odor. To neutralize the roasting gas, a smoke burner made of chrome-nickel steel alloy was developed using city gas which in a combustion chamber at 1000 C oxidizes quantitively all odorous substances. The discharge temperature of the purified gases is 450 C. To neutralize the residual odor still emanating from the work rooms of the plant, the air was channeled with the help of powerful ventilators by means of air ducts into a second smoke burner where combustion of the odor-laden air took place and eliminated what odor was still emanating from the plant after the roasting odor was neutralized. Newly designed equipment for chocolate and related factories is now being built (vacuum containers with agitators and vacuum pump heated by a steam jacket) which eliminate the emission of odors by plants using such equipment. The vacuum pump draws off the odor containing air which is absorbed by the cooling water and discharged into the drainage system.

22538

Kikuchi, Kazumasa

OFFENSIVE ODOR REMOVAL BY COMBUSTION AND THE DEVELOPMENT OF THE APPARATUS. (Nenshoho ni yoru akushu jyokyo sochi. Nensho dasshu sochi no kaihatsu). Text in Japanese. Akushu no Kenkyu (J. of Odor Control), 1(2):43-50, June 20, 1970.

An invention for deodorizing an ill-smelling waste gas is reported. The device operates by burning the gas at high temperature to convert ill-smelling particles into ultra-fine particles, which are subsequently subjected to thermal decomposition. The combustion chamber consists of two concentric cylinders. The ill-smelling gas is first introduced to the space between the two cylinders and flows down along the inner cylinder before entering the inner cylinder. As it flows along the inner cylinder the gas is rapidly heated up and becomes ultra-fine particles, since the inner cylinder is heated at 1400-1600 C by a burner. Infra-red light is also employed to decompose the ill-smelling elements by oxidation. High-pressure hot air jets are emitted from around the burner frame to obtain the maximum heat from the crude oil combustion. High temperature exhaust gas from the device is efficiently utilized to reduce the running cost. Odor removal of 90-95% is achieved. The whole system can be made portable to be used for an excreta-collection vehicle. Propane gas is used as fuel. A test showed an odor-removal rate of 95-99%. Test procedures for odor, bacteria, ammonia, hydrogen sulfide, and sulfur dioxide are described in detail.

22550

Loehr, Raymond C. and Samuel A. Hart

CHANGING PRACTICES IN AGRICULTURE AND THEIR EFFECT ON THE ENVIRONMENT. CRC Critical Rev. Environ. Control, 1(1):69-99, Feb 1970. 67 refs.

Animal production is discussed in terms of productivity increases, changes in size of operations, handling problems, waste characteristics, surface and ground water quality, land application of wastes, land runoff, odor production, and waste management techniques. Confinement feeding of livestock and increased numbers of animals per production unit have created large volumes of wastes with low value and societal and/or economic restrictions that limit the feasibility of recycling animal wastes through the soil environment. Animal wastes may contribute to water pollution in many ways such as: excessive nutrients that unbalance natural ecological systems and increase eutrophication; microorganisms that may impair the use of surface waters for recreational use; impurities in ground water; contaminants that complicate water treatment; and depletion of dissolved oxygen, causing fish kills. While odors can be reduced by proper sanitation in production facilities and by proper treatment facilities, odor control is both difficult and costly. Pollution characteristics of animal wastes are presented tabularly. Handling and storage techniques are discussed, as well as water problems and land disposal. Agricultural runoff is the major source of nutrient and silt pollution to Lake Erie; increasingly larger quanitities of nitrogen and phosphrous fertilizers are being applied to the land and find their way to the lake during runoff. Odor and dust production and control are discussed in detail, as well as site selection of agricultural operations.

22837

Monscvitz, Joseph T. and Leonard D. Ainsworth

DETECTION AND CONTROL OF HYDROGEN POLYSULFIDE IN WATER. Public Works, 101(9):113-115, Sept. 1970. 11 refs. (Presented at the American Chemical Society Meeting, April 1969.)

During the processing of ground or surface water supplies containing hydrogen sulfide, post-treatment odors sometimes occur and are usually attributed to deterioration of water quality in the distribution system. Existence of the problem is usually evident by the appearance of a milky-blue turbidity and, upon heating, the pungent odor of hydrogen sulfide. As determined by the authors, the source of the odors is the polysulfides produced by the natural or chlorine oxidation of sulfides. The answer to making the nuisance sulfur species susceptible to chloride oxidation appears to lie in converting them to a relatively stable sulfate end product, with sulfite ion used as intermediate. The stable sulfate can be oxidized by post-chlorination. While current laboratory tests of additives containing or hydrolyzing to a sulfate ion are centering on sodium metabisulfite, sulfur dioxide may be used in future tests.

22838

Sweny, John W. and John P. Valentine

PHYSICAL SOLVENT STARS IN GAS TREATMENT/PURIFICATION. Chem. Eng., 77(19):54-56, Sept. 7, 1970.

Selexol, a new process, is applicable for removing and recovering hydrogen sulfide, in high or low volume, from sour natural gas; full removal of carbon dioxide from sour natural gas and from synthesis gas before conversion to ammonia and methanol; H2S and CO2 from refinery processes; and carbon oxysulfide, carbon disulfide, and other sulfur compounds from a gas stream. A photograph and flowsheet are shown of a Selexol facility at Ft. Stockton, Texas, which removes 97% of the H2S and 86% of the CO2 from gas gathered in the Oates field. Capital and operating costs are lower than for chemical-separation methods. Steam regeneration, large cooling systems, and extensive heat-exchange equipment are practically eliminated. Due to its special solvent, the dimethyl ether of polyethylene glycol, the Selexol flowscheme can accept very high loadings of acid gases such as H2S and CO2, sulfur compounds like COS, CS2, and mercaptans without solvent degradation. It also gives extremely quick response to changes in feed-gas composition. The solvent itself is noncorrosive, nontoxic, and inherently nonfoaming.

22988

Okuno, Toshihide

THE CHEMICAL COMPONENTS OF ODOR FROM PLASTIC PLANTS AND SOME EXAMPLES OF ODOR CONTROL. (Purasuchiku kojo yori haishutsu sareru akushu kagaku seibun oyobi sono dasshu taisaku). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(1):46-50, April 20, 1970. 2 refs.

Chemical change of odor bearing waste gas in the course of syntheti resin processing and some odor removal measures in practice at plastic plants are discussed. Because of the diversity in the synthetic products, odor components and organic compound residues are also different. The typical process for acrylic acid ester compounds production involves a closed reactor to prevent self-polymerization of monomers due to sunlight and oxygen, and polymerization occurs in the nitrogen stream. In this process the monomer-tank, the reactor and the storage tank are the possible sources of odor emission. Characterized by their irritating odor, acrylic acid ester compounds even with a concentration below 1 ppm can be perceived from 20 m away. Adsorption, catalytic oxidation, combustion, and chemical solvents methods can remove this odor. Some examples of odor removal by the use of chemical solvents are demonstrated. In a process where plastic paint is made of resin mixed with other synthetic materials, resin odor stimulates eyes and throat. The result of ga chromatography made on terpene gas has indicated that in a thermal treatment tall rosin was greater in terpene emission than gum rosin. Settling of terpene gas by cooling treatment can be an odor countermeasure due to the difference in the boiling point of terpene gas and resin acid. Some resin acid which is difficult to settle by cooling can be neutralized by an alkaline substance.

23002

Morikawa, Takaaki and Isao Fujita

CLOSED SYSTEM ODOR REMOVAL PLANT FOR ANIMAL FIBERS, RUBBISH AND FATS. (Senkuzu, niber, jushi nado no mippeihoshiki ni yoru kanze dasshu no puranto). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(1):61-65, April 20, 1970.

Manufacturers of cooking oil and livestock feed have been the biggest producers of odor in the community. A disposal plant was established to improve the waste quality and to solve the odor problem at the the same time. Raw animal fat of high quality and with 75% oil content is attractive from the standpoint of oil and fat processing. Other animal rubbish and fibers consist of as much as 50% water and gelatine and are rather hard to be utilized for oil and fat processing and also for livestock feed. The main efforts were directed to eliminate the drawbacks of the conventiona type of open kilns. The local overheating of the kiln due to the oilburner it uses scorches the materials and results in poor-qualit oil and fat byproducts. The merit of the currently devised plant can be characterized as its closed system. The kiln designed to collect odor bearing vapor and to send it to a pressure reducer where the emission gas is mixed with water for dilution effect. Th material can be treated to a better quality under reduced pressure along with less temperature variation according to the kind of raw materials being processed. Odor contained in the vapor can be reduced. The flowchart of this closed system plant and related data are presented.

23008

Vandaveer, F. E.

THE DOMESTIC GAS-FIRED INCINERATOR'S ROLE IN AIR POLLUTION CONTROL. J. Air Pollution Control Assoc., 6(2):90-97, Aug. 1956. 15 refs.

Progress in the development of a smokeless, odorless, fly ash-free, domestic gas-fired incinerator is reported. Test charges and methods for producing and determining odor, smoke, and fly ash were selected. Two-stage incineration with gas heat in both stages is necessary to eliminate smoke and odor from domestic incinerators, the first stage for burning the garbage and paper, the second stage for oxidizing the smoke and odor. For second stage incineration, catalysts impregnated on porcelain or on chrome alloy heated to 500-700 F, ceramic balls or slabs heated to 1400-1500 F., stainless steel grids heated above 1400 F, smokeless downdraft combustion with a gas afterburner, and the flame of a gas-fired afterburner may be used. Drawings of two prototype models of smokeless, odorless and fly ash-free incinerators, and test data on them, are presented. Major changes and additions to gas association requirements for approval of domestic incinerators are reported. Drawings are presented of two commercially-developed incinerators being field-tested, one with a gas-heated catalyst in the second stage and the other with downdraft combustion and a combined incineration burner and gas flame afterburner. Calculations made from published data show that an incinerator in every house in a large city should not cause an increase in nitrogen oxides, sulfur dioxide, or aldehydes in the atmosphere to anywhere near the allowable maximum level for health. (Author summary modified)

23067

Springer, Karl J. and Charles T. Hare

FOUR YEARS OF DIESEL ODOR AND SMOKE CONTROL TECHNOLOGY EVALUATIONS- A SUMMARY. Preprint, American Society of Mechanical Engineers, N York, 16p., 1969. 7 refs. (Presented at the American Society of Mechanical Engineers, Winter Annual Meeting, Los Angeles, Calif., Nov. 16-20, 1969, Paper 69-WA/APC-3.)

Methods to control smoke and odors from diesel engines are considered. The reduction of smoke from new engines may be affected by engine design, fueling, and combustion alterations. Maintaining the reduced levels will depend on maintenance, driver, and fleet practices. Effective control of diesel odor continues to be elusive, although a few approaches such as catalytic mufflers and improved fuel injection for one type of engine have demonstrated merit. Much remains to be done in both smoke and odor areas of diesel emission control technology to identify new control methods and to investigate their performance and cost-effectiveness relationships. Evaluation and measurement techniques are described for the various control mechanism tests. (Author abstract modified)

23117

Shigeta, Yoshihiro

KRAFT PULP MILL ODORS AND THEIR COUNTERMEASURES. PART II. (Kurafuto parupukojo no akushu to sono taisaku. sono ni). Text in Japanese. Akushu no Kenkyu (J. of Odor Control), 1(2):35-42, June 20, 1970. 14 refs.

The odors from kraft pulp mills originate in the cooking, evaporation, and recovery processes which are all more or less related to the use of chemical solvents and agents. Odors produced through chip cooking depend on the types of woods, cooking temperature and time, and on the concentrations of sulfur compounds. The control of steam containing gas emission from the digester and the blow tank is the first effective countermeasure. In a batch type unit, odor emission can be reduced when steam thus lowering the blow gas and the waste gas temperatures down to exchanger thus lowering the blow gas and the waste gas temperatures down too below 60 C. Another feasible means of removing odor in a cooking process is the chlorine water contact and combustion method where the waste gas temperature is lowered to about 50 C by washing then preheated to between 80 C and 90 C for drying and finally burnt at 700 C for 0.8 second in a heavy oil burner. Oxidization of kraft black liquor is recommended for the removal of odor in the evaporation process. Kraft black liquor collected in solvent recovery boilers can be changed by pyrolysis into sulfur compounds most of which are combustible. It is noted that these odor removal techniques have to be applied very carefully in terms of boiler operation less excessive loads in a recovery boiler shoul result in the increase in H2S generation.

23319

Briganti, Antonio

FILTRATION OF ATMOSPHERIC AIR. (La filtrazione dell-'aria atmosferica). Text in Italian. Condizionamento dell'Aria Riscaldemento Refrigerazione (Air Conditioning Heating Cooling), 6(14):215-225, June 1970.

A classification of relative size, weight, and percentage of particles present in the atmosphere is given. Particles below 1 micron represent 99.9% of the number, although they represent only 30% of the total weight. Methods for evaluating the efficiency of a filter are Air Filter Institute Code Test (based on weight), National Bureau of Standards (calorimetric method), and D.O.P. (numerical or photometric method). Each of these methods is useful to evaluate a single and unique class of filters, characterized by a well-defined field and performance: the AFI, for low efficiency filters; the NBS, for medium efficiency filters; and the DOP, for high efficiency filters. To evaluate the difference among filters with different filtration efficiencies, but obtained with the same method, the index of quality K is introduced, and its expression is given. Two mechanisms of filtration for coarse filters and for very fine filters are presented in addition to a series of elements helpful in evaluating the useful duration of the filter and the mathematical expression of the useful time of a filter (in hours). Physical characteristics of absolute filters, microfilters, and active charcoal filters are indicated. Some microfilters can be constructed with programmed variable filtrating efficiency. Charcoal filters (to be used in conjunction with a preceding stage of dust filters) are mainly used to eliminate odors.

23371

Bretscher, Hans

ELIMINATION OF MALODOROUS EMISSIONS IN THE CHEMICAL INDUSTRY. Chem. Engr. (London), 46(7):268-270, Sept. 1968.

Meteorological conditions are an important factor in the emission of odorous pollutants, for example in the frequency of unpleasant odors during the night. The best method available at present for analyzing odors is gas chromatography, particularly for odors from traces of organic compounds. Measures for control of malodorous emissions in the chemical industry fall into three groups: (1) prevention of waste-gas components at their origin by plant and process design and/or modification; (2) a variety of suitable processes for purifying waste gases; and (3) dilution in the atmosphere from stacks. Since purification methods cannot yet provide complete removal of odorous components, they must be combined with stack expulsion for adequate dispersion. Effective organizational administration is essential to the success of any control program. Areas recommended for intensive future work are meteorology (tracer methods to rapidly gain regional information, and improved wind gauges), improved and lower-cost gas chromatography analyzers, and process-engineering measures to eliminate 'olfactorily intensive' substances.

23456

Olsson, Hans

FOOD INDUSTRY-VENTILATION FOR MACHINES. (Livsmedelsindustri- ventilation for maskiner). Text in Swedish. VVS (J. Assoc. Heating, Ventilation, Sanit. Engrs.) (Stockholm), 61(1):20-25, Jan. 1970.

Air pollution is mainly a problem of odors in the food industry. Compared with other gaseous pollutants, odors are a difficult technical problem. There are different methods to reduce the concentration of odors, such as ventilation, adsorption, absorption, chemical reaction, and combustion. To choose the right air cleaning equipment is difficult. It seems that good processing and acceptable localizing are as effective as any air cleaning equipment.

23493

Ochs, Hans-Joachim

AIR PURIFICATION IN A ROLLING MILL. (Umlufreinigung in Walzbetrieben). Text in German. Wasser Luft Betrieb, 12(2):70-72, Feb. 1968.

Practical experience with various types of air filtering systems indicates that the electrostatic filter is to date the only type capable of handling the dust problems in a rolling mill. A detailed description is given of an electrostatic air filter operating on the Penney principle. According to tests conducted by the US National Bureau of Standards, when the airflow velocity through the filter is 1.7 meters per second, the electrostatic filter removes at least 90% of the dust. If the velocity is slowed to less than 2 m/sec, the separauing efficiency approaches 100%. The operating temperature should not exceed 60 C. The electrostatic filter offers the additional advantage of removing many unpleasant odors, by virtue of the fact that much of the odoriferous material is bound to liquid particles suspended in the air. The ozone created by the electrical discharges also provides a means of oxidizing undesirable gaseous components in the air. The principal impurity to be removed from air aspirated from above a cold-rolling mill is an oil mist, while in the case of a hot mill the chief product is an oil-water emulsion. The normal airflow velocity from an operating mill is 1.7 m/sec., whereas the use of the electrostatic filter requires a rate of flow not exceeding 1.3 m/sec; the ideal rate is 1.0 m/sec., or 60% of the rate corresponding to maximum operating efficiency. The specific problems relating to the removal of oil mists and oil-water emulsions are discussed, together with some brief comments on the economics of the filtering system.

23538

Nolan, William J.

PREPULPING CHIP EXTRACTION TO REDUCE AIR POLLUTION. FINAL REPORT AND RECOMMENDED FUTURE RESEARCH. Florida Univ., Gainesville, Engineering and Industrial Experiment Station, PHS Grants AP 00612-01 and AP 00612-02, 18p., Jan. 17, 1970.

Results are summarized and future work recommended from a study to determine whether rosin removal from chips before kraft pulping would permit efficient oxidation of dilute black liquors, and to explore the pulping of rosin-extracted chips by the neutral sulfite process. Prepulping rosin extraction had no benefits in black liquor oxidation. The following conclusions were drawn from this and other phases of the investigation: (1) Pulping of the southern pines with sodium sulfite solutions instead of conventional kraft solutions of sodium hydroxide and sulfide will prevent the formatio of mercaptan, hydrogen sulfide, dimethyl sulfide, and disulfide, thus eliminating the air pollution problem characteristic of kraft pulping. (2) Sodium sulfite pulping (pH range 8.5-7.8) will produce pulps with improved yield in the range of 62-68%, with strong burst, tensile, and tear characteristics. (3) Small additions of sodium carbonate to the sodium sulfite liquors may benefit pulp strength. (4) Two-stage pulping with fibration between stages will improve pulp quality with probable lower equipment costs. (5) Three-stage screw press washers will reduce stream pollution to less than a fourth of that caused by conventional 3-stage vacuum washers. (6) Conventional kraft recovery equipment can be used to recover sodium sulfite waste liquors, replacing the recausticizing unit used in kraft recovery by three gas absorption towers. (Author summary modified)

23594

Kellum, James

SEWER ODOR CONTROL. Water Wastes Eng., 7(7):43, July 1970.

A newly developed process is available for the control of odors in sewers, lift stations, and sewage treatment plants. The process involves the installation of a gas-producing unit into which air is introduced and passed through a series of baffles. With the passage of the air, electrical current is continuously discharged across the space between the baffles. The result is the production of an activated mixture of gases that, when discharged into a lift station or sewer line, eliminates more odors and prevents septicization and the formation of hydrogen sulfide. When used for upline treatment, the process is reported to raise the DO content of the liquid, promote aerobic biological growth, and reduce BOD where sufficient retention times are available. Other advantages claimed for the process and equipment are discribed.

23836

LaRue, Phillip G.

SMOKELESS AND ODORLESS DOMESTIC INCINERATORS. (Calcinator Corp., Bay City, Mich.) U. S. Pat. 3,527,177. 7p., Sept. 8, 1970. 7 refs. (Appl. Jan. 4, 1968, 12 claims).

An incinerator for the smokeless and odorless burning of domestic rubbish is described. The off-gases of the primary combustion chamber are channeled into the path of a torch-like burner where they are heated to an elevated temperature, mixed with additional oxygen, and forced to take a definite time-delay path in order for recombustion to take place before the gases are vented to the atmosphere. A venting mechanism is provided which reduces the temperature of the gases from the secondary chamber before they are released to the atmosphere. The incinerator is of a compact and efficient design and utilizes a minimum number of parts.

23885

Baum, Fritz and Werner Brocke

PRACTICAL EXPERIENCE WITH THE CONTROL OF OIL BURNERS FOR THE REDUCTION OF SOOT EMISSIONS AND ODOR ENVELOPMENT. (Praktische Erfahrungen bei der Kontrolle von Oelfeuerungen zur Verminderung des Russauswurfs und der Geruchsentwicklung). Text in German. Staub, Reinhaltung Luft, 30(8):328-333, Aug. 1970. 23 refs.

A successful annual testing of more than 300,000 oil-firing plants in North Rhine-Westphalia requires the use of the filter paper method for a reliable detection of particle emissions (soot), and of the pyridine test for detecting odorous components (oil derivatives). A series of special investigations has clarified the relationship between the test gas volume and soot number, between soot concentrations and soot number, and also between the emission of oil derivatives and nuisance caused by odor. Reliably regulated atomizing burners of good construction used for EL fuel oil ensure soot concentrations well below 10 mg/N cu m and odorless waste gases.

23901

Morgan, John P.

ODOR CONTROL IN KRAFT PULP MILLS. Chem 26, 6(9):30-34, Sept. 1970.

Bivalent sulfur compounds in various gaseous effluents are the main source of odor from Kraft pulp mills. Systems for reducing odors from digester and multiple evaporator areas, from black liquor oxidation, and from contaminated condensate are detailed. The system for the non-condensables from the digester and evaporator areas is based on a special burning system operated on the simple principle of an inverted chamber inside a contaminant tank partially filled with water to provide a gas seal. Gases from the evaporators are scrubbed with a recycled caustic. A strong black liquor oxidation system prevents hydrogen sulfide stripping and reduces lime reburning requirements. Treatment of the contaminated condensate is effectly handled by air stripping alone or in combination with thermal oxidation processes.

23967

Hardison, L. C.

GASEOUS WASTE DISPOSAL. Ind. Gas, vol. 47:16-23, July 1968. (Presented at the East Ohio Gas Co. seminar on waste disposal, Cleveland, Ohio.)

The three basic oxidation processes for incineration of waste gases are flame, thermal, and catalytic incineration. The three differ basically in the temperature to which the gas stream must be heated. Flame incinerators are most often used for closed chemical reactors; however, if the concentration of combustible contaminants in air air stream is well below the lower limit of flammability, direct thermal incineration is considerably more economical. Catalytic incineration is widely used for the oxidation of paint solvents, odors from chemical and food operations, and for other functions that help offset the cost of air pollution control equipment, it operates below the limits of flammability and below the normal oxidation temperatures of the contaminants. The catalytic systems are the least costly when comparisons are made at the optimum level of heat recovery. Details of the three methods are given, particularly in terms of the operating costs of the equipment; several applications are briefly considered, including wire enameling, metal lithography, and kettle cooking. Carbon absorption and wet scrubbing are among the alternatives for some applications where incineration is not appropriate. The general steps in choosing a gas disposal system for a particular emission are outlined.

24065

Schiele, G.

ELECTRICAL CLEANING OF WASTE GASES FROM ELECTRODE FURNACES. (Elektrische Reinigung der Abgase aus Elektrodenbrennoefen). Aluminium, 43(3):171-174, March 1967. 4 refs. Translated from German. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 16p., Nov. 4, 1969.

Flue-gas of electrode firing kilns contains extremely fine tar mists of fractions having different boiling points. Particularly during temperature inversion conditions, the usually disagreeable odor can constitute a great nuisance in both the closer and more distant environment. On account of its fineness, the mist can be separated most effectively by electrostatic filters. The higher the operating voltage of the electrostatic filter, the better is the separation. However, the voltage cannot be raised arbitrarily high, since it will ultimately lead to electrical discharges between the spray and the precipitation-electrodes. One should strive to cool the flue-gas before tar separation to such an extent that the renewed condensation of tar mists after cleaning is as slight as possible. At a temperature of about 70 C, the vapor pressures of the tar oils in question are already so low that, on dilution of the flue gas with atmospheric air and on cooling of the mixture, they remain in the aerosol form and evaporate very rapidly. Methods of cooling are discussed, as well as effective means of controlling the danger of fire.

24079

Gommi, J. V.

DESIGN AND OPERATION OF ACE SYSTEM FOR KRAFT ODOR REDUCTION. Paper Trade J., 154(27):44-46, July 6, 1970. 8 refs. (Presented at the American Institute of Chemical Engineers National Meeting, 67th, Atlanta, Ga., Feb. 15-18, 1970.)

The air contact evaporator (ACE) system eliminates the kraft recovery furnace contribution to total reduced sulfur emission by eliminating gas contact with black liquor. In this system, hot gases leaving the economizer are cooled in a regenerative Ljungstrom-type heat exchanger whose heat absorbing surface is composed of closely-spaced elements. The heat is given up by the rotation of the surface into the incoming air stream. The resulting air is sufficiently hot to be used in a cascade evaporator to concentrate black liquor to 68% dry solids. It is then routed to the furnace for use as combustion air. With the system, there is no carbon dioxide present to contact the black liquor. In addition, no volatiles or products of hydrolysis can escape to the stack; whatever small amounts might theoretically be present are swept into the furnace and oxidized to SO2. Pilot development of the system and the first commercially installed unit are discussed. The latter gives lower levels of odorous reduced sulfur with unozidized liquor than required by any existing state code.

24090

HIGH-ENERGY AIR FILTER FOR REDUCING INDUSTRIAL EFFLUENTS. Filtration Eng., 1(9):9-13, May 1970.

Faced with a tacky organic smoke emission from two of its major processes, asphalt saturation and the baking of phenol-formaldehyde binders, Johns-Manville set about developing a technique for dealing with the effluent. The key to the process developed, called HEAF, for high-energy air filter, is the utilization of high velocity effluent air through a fiberglass filter medium. Increasing efficiency is due either to an increase of inertial forces, which throw the particle against the fibers and capture it by that mechanism, or by compression of that material at higher flow rates and pressure drops. It has rarely been reported that odors are due to particulates, but the results obtained with the two effluents tested seem to indicate that the liquid particulates in these effluents are almost the sole cause of odor. If this were not so, there would not be such a close correlation between the odor-removal efficiency and the particulate-removal efficiency. An economic comparison of seven different systems designed to filter 30,000 cu ft per minute from a roofing plant saturator is presented tabularly.

24197

Elnicki, Walter

A CONTROL MODE FOR AIR POLLUTION. All Clear, 2(3):15-16, May/June 1970.

Thermal incineration is a process of oxidation of the organic material in a waste gas by means of bringing the gas to a temperature above the automatic ignition temperature of the combustible, and holding it there long enough to oxidize it. These contaminants may be odors and/or solvents in the gaseous form. In order to obtain good conversion efficiencies, the hydrocarbons must be heated to temperatures between 1300 and 1500 F with a residence time of .3 to .6 seconds. The design of a thermal incineration system must incorporate temperature, holding time, and turbulence of the waste air stream to produce proper clean-up efficiencies. When properly baffled, the holding chamber will produce enough turbulence to get thorough mixing of the waste gases to produce maximum burning. It is extremely critical that the minimum allowable exhaust rate be used, since the air flow rate governs the amount of gas which is burned, the size of the incinerator, the exhaust fan, and relative ductwork to feed the thermal incinerator. Costs can be reduced with the addition of heat exchangers to preheat the process exhaust air, and/or to heat make up air to supply back to the process, or to heat air from space heating in the building itself.

24380

Kuzuma, Junji, Tadashi Sakurai, Isao Koyama, Tatsukichi Ishiguro, and Toshio Odaira

RESEARCH ON ODOR EMITTED FROM FISH MEAL PLANTS. (Gyochokotsu shorikojo no akushujokyo ni kansuru chosahokoku). Text in Japanese Tokyo-to Kogai Kenkyusho-ho (Ann. Rept. Tokyo Metropol. Res. Inst. Environ. Protection), Sect. 1:140-155, Jan. 1970.

A general description of fish meal processing plants is given, and the number of complaints received in each district of Tokyo concerning smoke, dust, and odor are listed in a table. Flow chart describe ordinary fish meal processing as well as the continuous sealed process. Removal of bad odor from the drying process and from the liquid resulting from the pressing process were investigated. The methods tested for odor removal in the drying process were chemical scrubbing, ozone oxidation, and sulfonic carbon adsorption. Odor samples were tested by organoleptic methods, gas chromatography, and absorption photometry. Each odor removal process is explained in detail; diagrams are given; and some of the measurement results are tabulated according to the odorant chemicals such as ethyl mercaptan and diethyl sulfide. For press liquid, the samples were quantitatively analyzed for water content, crude protein, and crude fat. The results show that a process such as the one involving indirect heating of the juice in a sealed tank, passing it through the desludger, and the three-laye separation and concentration in the evaporation chamber would preve odor emission. A detailed table is given on the analysis of the components of the liquid at various processing stages.

24743

Damon, W. A.

ABATEMENT OF AIR POLLUTION IN THE CHEMICAL INDUSTRY. Chem. Ind. (London), vol. 41:1266-1270, Oct. 8, 1955. 11 refs. (Presented at the London Section of the Society of Chemical Industry Symposium on the Prevention of Atmospheric and Water Pollution in the Chemical Industry, London (England). (April 4-5, 1955.)

The special problems of air pollution arising from chemical processes are largely dealt with under the provisions of the Alkali etc. Works Registration Act, 1906, and the Alkali, etc., Works Regulation (Scotland) Act, 1951, as extended by subsequent legislation. Those processes that are considered to be the greatest potential contributors to air pollution are defined and not permitted to operate in the absence of control equipment for noxious or offensive gases. In connection with certain processes, e.g., sulfur acid manufacture, statutory limits of acidity are laid down; but, in general, reliance is placed on the use of the best practicable means. Suitable methods of treatment are given for noxious constituents of chemical reagents, odorous permanent gases from petroleum refining processes, sulfur oxides from fuel combustion, and waste gases from metallurgical processes, including electrolysis of alumina. It is emphasized that the control of these sources often requires changes in the processes themselves.

24810

PLANT SERVICES BEAT EXPLOSION HAZARDS. Mod. Power Eng., 64(11): 40-44, Nov. 1970.

Modern air conditioning and dust control techniques in a Canadian flour mill have produced a virtually dust-free atmosphere and drastically reduced the need for explosion-proof electrical equipment. In addition, dry-cleaning of raw wheat grains, as opposed to water washing, has eliminated odors. The dust collection system comprises five separate systems, each using bag filters. In the cleaning section, the dust collector aspirates all receivers on intermediate relift conveyors and the screenings section conveyor. In addition, all cleaning machinery, feeders, and screw conveyors in the cleaning section are aspirated through this filter. Clean exhaust air from this and the other filters is fed to an air make-up unit which creates a positive air pressure within the mill and prevents the build-up of dangerous dust concentrations.

24845

Takei, Kazuo

DIESEL ENGINE EXHAUST SMOKE. (Diizeru kikan kaikien). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 6(9):547-552, Sept. 25, 1970. 4 refs.

Although generally considered less objectionable and dangerous than petrol engine exhausts, diesel engine exhaust gases nevertheless constitute an important air pollution problem because of their smoke and odor. The chief sources of troublesome emissions are hydrocarbons, nitrous oxides, carbon monoxide, and aldehydes. Suppression of pollutants in diesel exhaust is the subject of a wide research effort, with particular emphasis on barium-containing fuel additives. The main causes of unusually black smoke are often inadequate engine installation and tuning, such as improper adjustment of the injection pump. Thus, diesel smoke can be suppressed principally by effective maintenance. Smoke from an old or overloaded engine can best be controlled by effective use of the barium additives.

24969

Rueb, Friedmund

A PROCESS FOR THE NEUTRALIZATION OF TOXIC VAPOURS AND WASTE GASES. (Verfahren und Anlagen zur Unschaedlichmachung giftiger Daempfe und Abgase). Text in German. Wasser Luft Betrieb, 11(2):65-70, 1967.

Offensive, toxic, or noxious waste gases emanating from various industrial processes are neutralized by absorption, by adsorption on activated carbon or by catalytic combustion. Processes include the old method of washing acid waste gases in adsorption towers with chemically resistant polyvinylchloride or polyethylene lining by means of water or of alkaline washing liquids and the new method of wet pressure change separation which divides the stream of gas into thin layers by numerous ducts which system is suited for the separation of aerosols and for gas purification by absorption. Adsorption on activated carbon permits the recovery of valuable solvents which is accomplished by various methods depending on the degree of water solubility of the substance to be recovered. Catalytic combustion operates with temperatures between 150 and 400 C and is often employed where offending odors must be controlled like in the production of phthalic and maleic acids where naphthoquinone, benzoic acid and carbon monoxide must be destroyed because they are toxic and corrosive. Currently widely used is a modern arrangement consisting of two steel towers where SO2 containing gases are washed with diluted ammonia. Other methods separate aerosol fogs by means of electrofilters with simultaneous recovery of the pollutant and control of objectionable odors emanating from biological processes by biofilters in which certain bacterial strains deodorize the air by consuming the offending substances as food.

24988

Teyogi, N.

EXHAUST FROM DIESEL ENGINE. (Diesel Haiki). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), vol. 6(9):539-546, Sept. 25, 1970. [illegible] refs.0

Studies of pollutants, such as black smoke, hydrocarbons, carbon monoxide, nitrogen oxides and aldehydes and of diesel exhaust odors are presented. It is not clear how much the pollutants contribute to air pollution in urban areas, but citizens object to the black smoke and bad smell of the exhaust. Of the numerous smoke-meters developed, to measure diesel smoke, none has proved satisfactory. Hydrocarbons are considered to contribute to the generation of photochemical smog, and benzopyrene, a carcinogen, is found in diesel exhaust. It is not known how factors like fuel composition and operation of engine affect the generation of the latter. Maximum CO levels under normal operation are 0.25-0.5%; these levels will be permissible for some years to come in Japan, but will not be tolerated in the U. S. after 1975. Nitrogen oxides can be reduced by modifying engine design and operating conditions. Aldehydes are suspected to promote photochemical reaction. Since the cause of diesel exhaust odor is unknown, only subjective evaluation by a human panel is possible so the problem is difficult to solve. A Catalytic muffler or reactor is effective in reducing the smell of diesel exhaust. Exhaust deodorant fuel additives have been tried but without conclusive results. Efforts to solve exhaus problems from diesel engines have just started, and many problems remain.

25017

Stokes, Rufus

AIR POLLUTION CONTROL DEVICE. (Assignee not given.) U. S. Pat. 3,520,113. 7p., July 14, 1970. 7 refs. (Appl. Jan. 8, 1968, 8 claims).

An improved apparatus is described for removing impurities in the form of particulate matter, gases, chemicals and odors from exhaust fumes or other gases, prior to exhausting them into the atmosphere. In the smelting business, especially in the reclaiming of metals such as lead and zinc, a real problem exists where extraneous material such as, for example, rubber insulation on the metals, is burned by the heat of the molten metal. Apparatus including cyclone filters, bag filters, electrostatic precipitators and the like have been used in the past to remove these impurities; however, all of them are generally unsatisfactory, for one reason or another. The present process includes a high pressure blower system for forcing the exhaust gases into a primary mixing chamber, below the surface of the water, so that the fumes will bubble through the water upon rising to the top. As the fumes rise to the top of the water, additional high speed blowers draw them out of the primary mixing chamber and force them into a precipitator filter unit. In the precipitator filter unit, the fumes are washed by means of a water spray and are filtered to remove still additional particulate matter. The fumes are returned to another mixing chamber wherein they are retained under pressure, so that the gases are absorbed by the water within the chamber. From this mixing chamber, the gases flow into a settling chamber within the tank. (Author abstract modified)

25085

Lindberg, Erik Axel Sigvard

METHOD OF GETTING RID OF MALODOROUS AIR AND WATER POLLUTANTS FROM ALKALINE PULP COOKING. (Uddeholms A B, Uddeholm (Sweden) U. S. Pat. 3,520,772. 3p., July 14, 1970. 2 refs. (Appl. April 25, 1966, 1 claim).

In an alkaline pulping process, especially the manufacture of so-called 'sulfate pulp,' the noxious and malodorous gases and vapors leaving the digesters in the cooking of the wood chips, without passing through a condenser, are brought, together with steam from the digesters directly to a furnace, where the gases are burned or rendered innocuous by thermal decomposition. In the process described, the pollutant gases leave the digester together with steam and are passed directly to a furnace without passing through a condenser. The furnace where the combustion takes place is preferably associated with a conventional boiler, such as a soda recovery boiler, or a continuous lime kiln. The gases flow from the digester to the furnace without condensation of noxious constituents which when condensed would only be a different kind of nuisance; but they may pass through a superheater in order to prevent such condensation during such passage. Thus, not only is the atmosphere in the vicinity of the pulp mill protected from pollution by the discharge of noxious gases, but the streams and lakes and low places which might be used as settling ponds are also protected against pollution. The waste gases consisting of the pollutants mixed with steam from the cooking process and oxygen for the burning are proportioned so that the oxygen concentration is below that of an explosive mixture, so that the combustion is safe. The heat content of the gases can be recovered by use of a flue gas scrubber. Previous methods involve cooling the gases in a condenser, or destroying the noncondensible gases b combustion. The effluents of these operations either leave the plant in the form of water pollution, or require further expensive processing to be eliminated. The method described avoids these unnecessary problems. (Author abstract modified)

25224

Summer, W.

DEODORIZATION OF AIR AND OF WATER. (Das Geruchlosmachen von Luft und Wasser). Text in German. Staub-Reinhaltung Luft, 30(9): 371-372, Sept. 1970.

The control methods of osmogens through adsorption, absorption or precipitation suffer from the drawback that the osmogens are only transferred from one medium to another which then becomes an osmogen in its own right, only greatly concentrated. Normal combustion requires high temperatures not easily generated. Catalytic combustion while practicable at comparatively low temperatures has the drawback of the catalyst being vulnerable to catalytic poisons. At low concentrations of osmogens like 10 ppm, combustion as a control method is uneconomical. The only method of controlling small quantities of osmogens is the substitution of the atom in the molecule which causes the olfactory problem by nascent oxygen which can be produced by drawing air through a field of rays whose wavelength corresponds to the absorption spectrum of oxygen. As the short life span of atomic oxygen does not permit its transport, air to be deodorized must pass through the field of rays. Experiments disclosed that mercaptans, sulfides, and amines in the air can be deodorized by irradiation with an efficiency of up to 97%. Similarly, waste water containing H2S can be deodorized by expelling the dissolved H2S through blowing in air and treating the expelled H2S with atomic oxygen. An H2S content of 178 mg H2S/l H2O can be thus reduced to 12 mg/l H2O after a 30 minute treatment. Industrially applied, a volume of 7800 N cu m/h air containing 2.0 mg H2S/N cu m and 1.8 mg amines/N cu m was deodorized by 65-85% with an energy expenditure of 6400 W.

25379

(Inventor not given.)

DRYING APPARATUS COMPRISING A DEVICE FOR BURNING AND DEODORIZING ODOROUS GASES. (Kabushiki Kaisha Okawara Seisakusho, Shizuoka (Japan) and Tohzai Sango Boeki Co., Ltd., Tokyo (Japan)) Brit. Pat. 1,174,072. 3p., Dec. 10, 1969. (Appl. Sept. 26, 1967, 2 claims).

An apparatus is described for drying chicken droppings, or the like, which comprises a cylindrical rotary drum for stirring and pulverizing the droppings. Hot gases blown into the drum stir and dry the droppings. The odorous gases generated in the drying drum are led into a combustion furnace wherein they are deodorized upon oxidation, and the resultant deodorized gases are partially recirculated into the drum to be used for drying and partially released into the atmosphere.

25479

Rotterdam Soil, Water and Air Committee (Netherlands)

ROTTERDAM SOIL, WATER AND AIR COMMITTEE 1969 REPORT. (Commissie Bodem, Water en Lucht Verslag over het jaar 1969. Rotterdam). Text in Dutch, 60p., 1969.

The report of the commission responsible for dealing with ground, water, and air pollution in Rotterdam for the year 1969 includes sections on air pollution and the medical aspects of air pollution. The largest number of complaints (1440) turned in to the central office during the period reported on had to do with the Gekro Company, which seems to have made every effort within their financial means to prevent the dissemination of unpleasant odors. When a burner failed to do the job, two scrubbers were also installed. The difficulty could be avoided by relocation, but the cost of relocating the plant would be prohibitive. On the other hand, failure to bring action against the company would violate the spirit of the laws and regulations pertaining to this question. At the end of 1969, the commission saw little hope of resolving the problem. A total of 1326 complaints were received against the oil industry, but this situation is analogious to the first, except that the Shell Refinery has erected a high smokestack that has improved the situation in the Rotterdam suburbs of Hoogvliet and Vlaardingen. About 50% of home heating is now with natural gas, and about 85% for medium-sized plants such as for schools, office buildings, apartments, and small businesses. The 'nuisance laws' in this case cover 'noise pollution' as well as air pollution and citizens are entitled to complain of excessive noise to the appropriate office. The commission has designated an average sulfur dioxide concentration of more than 500 micrograms per cubic meter in a 24-hour period as a 'red light' concentration in terms of bronchitis risk, while a concentration of 350 micrograms for more than one day out of a month is designated as a 'yellow light' concentration. A number of air samples from the Rotterdam area were analyzed for asbestos content, inspired by recent published statements concerning a connection between asbestos and public health. A connection was established between asbestos and a certain type of tumor, but the problem so far seems to be one of occupational medicine rather than of public health.

25554

Henderson, Wayne L.

CATALYTIC OXIDATION UNIT FOR DOMESTIC OVEN EXHAUST. (General Electric Co., Schenectady, N. Y.) U. S. Pat. 3,536,457. 5p., Oct. 27, 1970. 9 refs. (Appl. Feb. 21, 1968, 2 claims).

A catalytic oxidation unit is described that eliminates smoke and odors issuing from the exhaust vents of domestic cooking ovens, particularly the high-temperature, self-cleaning ovens using a pyrolytic process for degrading food soils. The unit comprises a hollow housing supporting catalyst-coated gas burners of cellular ceramic construction and having a high surface-to-volume ratio. The housing has an intake port and an exhaust port and includes a partition which separates the housing into intake and afterburner compartments. Gas flow is directed from the oven cavity to the intake compartment, then through the catalyst-coated gas burners to the afterburner compartment, and finally to the exhaust port. Primary combustion air can be supplied to the intake compartment, while secondary combustion air can be supplied to the afterburner compartment to create afterburning of the oven exhaust. Complete degradation and conversion of gases to carbon dioxide is achieved since the velocity is automatically controlled and they are exposed to high temperatures for a sufficient amount of time. (Author abstract modified)

25594

Pardoe, E. S.

GASSING....THE BUG-A-BOO OF THE BUS BUSINESS. Bus Transportation, 16(10):480-482, Oct. 1937.

Experience with de-gassing valves for the control of exhaust gas odors from their buses led Capital Transit to look for a measure for odors. The first step was to collect samples of exhaust gas and test them qualitatively for aldehydes. Next, the susceptibility of different fuels to form aldyhyde was investigated. The third stage of these studies had as its objective to ascertain what engine operating conditions produced maximum exhaust fuming, developing a test technique for obtaining and analyzing these gases, and determining what engine and fuel characteristics were influential in controlling this. Probably the first result of the Esso Laboratories tests was a definite proof that, in this particular bus at least, the aldehyde content was 40 times greater in the exhaust when decelerating than when accelerating or running along. For any of the types of fuel tried, the aldehyde content decreased as the volatility increased. A general improvement of 78% was effected by the rigid adjustment of carburetor and ignition systems with a high temperature manifold and a total improvement or reduction in odor and fuming of 94% by the use of a more volatile fuel on top of the other improvements was made.

25623

Desiderati, Paul

ODOR CONTROL WITH CHLORINE CUTS COST. Water Sewage Works, 114(12): 469-470, Dec. 1967.

Chlorination was selected for odor control of hydrogen sulfide coming from sewage at the entrance of a wet well and at the effluent weir of the primary settling tank. On the basis of experience gained by running chlorine demand tests, the chlorine required for any given situation is indicated to be inversely proportional to the flow. The results of chlorine application for odor control was further demonstrated by taking grab samples during the day when the flow was 30,000 gph. Hydrogen sulfide tests were made to determine the effectiveness of odor control. Physical layout of the system which includes two 150 lb chlorine gas cylinders is described.

25694

Moehle, Fred W.

FLY ASH AIDS IN SLUDGE DISPOSAL. Environ. Sci. Technol., 1(5): 374-379, May 1967. (Presented at the Purdue Industrial Waste Conference, 22nd Annual, May 2-4, 1967.)

Dewatering industrial waste plant sludge using fly ash as a filtering aid has proved successful. To fully understand where the sludge comes from, how it is collected, and how dewatering is accomplished, the entire waste treatment plant operation is first described. Fly ash is introduced approximately 10 inches downstrea from the point at which the sludge enters the top of the sludge feed mixing conveyor. The optimum mixture should be in the range of four parts sludge to one part fly ash by weight. Dewatering starts when the mixture enters the filter, and the mixture continues to dewater, forming a cake on top of the drum. Because of a 15-20 inch mercury vacuum in the chambers beneath the cloth, the water is filtered out into the vacuum chamber. When a vacuum chamber rotates to the top of the drum, the vacuum is automatically shut off and compressed air at 3 psig is introduced to the chamber, dislodging the cake which then falls into a collecting chute. The dewatered sludge has no discernable odor. A sludge temperature of 65 C was most suitable. Some operating problems in using this method are mentioned.

25711

Jahnke, Herbert

ELECTROSTATIC CONDITIONING ARRANGEMENT. (Constantin Graf von Berckheim, Weinheim an der Bergstrasse, Germany) U. S. Pat. 3,531,150. 4p., Sept. 29, 1970. 5 refs. (Appl. June 5, 1968, 14 claims).

An arrangement is described for electrostatically conditioning the air in the passenger compartment of a motor vehicle. Such conditioning delays the development of fatigue and, at least to a certain extent, eliminates contaminants and odors from the air. The arrangement comprises an electrode mounting on the ceiling, insulation from the body of the vehicle, and a source of direct current supplying between 90 and 150 volts. Electrically conductive means are provided on at least one of the interior surfaces with which a passenger comes into contact.

25858

Schirz, Stefan

ON PROTECTION AGAINST EMISSION: REMOVAL OF OFFENDING SMELLS. (Zum Thema 'Immissionsschutz': Versuch der Geruchsbeseitigung). Text in German. Landtechnik, 25(21):672-674, Nov. 1970.

While offending smells emitted by agricultural enterprises raising large numbers of domestic animals for meat production are of low significance in the overall pollution picture, large scale animal farming is on the increase. In West Germany, the pig population increased by 120% since 1950 while the number of farms decreased by 52%. The use of chemicals to control the smells emitted presents no solution to the problem; on the contrary, this approach aggravates it because the chemicals emit their own pollution. Chemical processes allegedly destroying the smelly substances must be viewed with skepticism; it is more probable that the chemical reaction takes place on the nasal membrane which is de-sensitized to the smell. Similar caution is indicated in the case of ionization because ozone requires a long contact time to be effective and these conditions do not prevail in agriculture. Technical control methods including purification of air by scrubbers, filtering of air, and combustion of smells in the air are too expensive to be feasible. The only inexpensive and effective approach is the prevention of smells by the maintenance of maximal cleanliness in barns, pig pens, or chicken houses, by maintaining an optimal climate in these enclosures, by separating air emanating from manure pits from barn air, by mechanical cooling of manure piles and pits, and by covering open manure piles containers with muck, and silos containing fermented feed.

25950

Archibald, E. E., Jr. and A. van Donkelaar

AIR QUALITY CONTROL IN A BLEACHED KRAFT MILL. Preprint, Canadian Pulp and Paper Assoc., 14p., 1967. 10 refs. (Presented at the Paper Industry Air and Stream Improvement Conference, Third, Vancouver, B. C., Oct. 23-26, 1967, Technical Paper T346.)

The engineering equipment and practices employed at one bleached kraft pulp mill to reduce malodorous gaseous emissions are described. Black liquor oxidation combined with optimum conditions in the recovery furnace can reduce hydrogen sulfide emissions from the main stack to near zero. Noncondensibles from cooking and evaporation processes are successfully collected and subsequently destroyed with a high degree of efficiency by a system of incineration and/or chlorination. Typical emission data are tabulated. A home-monitoring system, supplemented by in-plant monitoring is providing information on changes and improvements in mill emissions.

25977

Osterli, Victor P.

AIR POLLUTION CAUSED BY AGRICULTURE AND FORESTRY: ODOR. In: Project Clean Air. California Univ., Berkeley, Task Force No. 5, Section 6, 4p., Sept. 1, 1970. 20 refs.

The development of methods to control odor at the site and for disposal of livestock and poultry fecal matter is a major need. One possible process, wet oxidation, could be of real significance since it would not only eliminate the fecal matter but would produce energy to carry out the disposal process and possibly even convert the wastes to animal feed. Treating the manure with chemical deodorants may provide a partial solution. A specific application of the pyrolysis-combustion process could be an alternative to current methods of incineration used which would eliminate or substantially alleviate the problem of malodors. Afterburner-type devices are available for some kinds of rendering plants to control odors. In addition to animal wastes and odors from meat processing and rendering plants, more than 28 million tons of wood pulp are produced yearly in the United States by the sulfate or kraft process which produces a pollution problem.

26002

Ishiguro, Tatsukichi

ODOR CONTROL IN FISH AND BONE MEAL FACTORIES IN NORTH EUROPE. (III). (DE LAVAL SYSTEM AND ATV SYSTEM). (Hoku ni okeru gyochokotsu, jukotsu to shori kojo no dasshu taisaku (sono III) (de rabaru hoshiki to ATV hoshiki ni tsuite)). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(3):54-63, Oct. 1970.

The de Laval system (Swedish) and the ATV system (Danish) for odor control in fish and bone meal factories are discussed, as well as an example in Tokyo. The Swedish system is characterized by being closed with odors collected into one place, minimizing the amount of air which escapes. An adequate balance is maintained between the amount of odor generated, wind, and the amount of water in the scrubbing tower. In the case of fish meal, it is best to combine washing and a combustion method. To prevent corrosion and the lowering of combustion efficiency, a demister and water trap are provided following washing. Also, after heating the gas, some part of it is burnt as secondary air which makes it easier to maintain a constantly high temperature in the furnace. The ATV method is also a closed system. Asbestos plates are arranged in the scrubbing tower, which is equipped with special nozzles. After the air is washed, it is burnt in a boiler at 750-1100 C.

26014

Hoshika, Y. and T. Ishiguro

QUALITATIVE ANALYSES OF ODOR COMPONENTS IN THE PYROLYSIS OF FEATHER IN THE LABORATORY TEST. (Feza kanetsu shoriji ni hassei suru shu seibun to sono taisaku--tokuni akurorein no kakunin ni tsuite). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(3):34-44, Oct. 1970. 5 refs.

Feather treatment in the rendering process generates odorous acrolein in amounts of 0.01 to 0.1 ml out of 25 mg of feather. In addition to acrolein, such odorous gases as methyl mercaptan, acetaldehyde, diethylamine, n-propylamine, ammonia, and hydrogen sulfide are also generated. A pyrolysis method should be adopted, and a low temperature condensation method should be applied to eliminate water, or an electrical water elimination method developed, so that the rendering process can be accomplished without heating. If a heating process cannot be applied, use of 2,4-dinitrophenylhydrazine in a scrubbing tower is recommended. The rendering process is explained, and a pyrolysis flow sheet is provided.

26056

Nishida, K.

THE REMOVALS FOR THE STINKING COMPOUNDS BY SPRAYING THE DEODORANT SOLUTIONS. (1). (Dasshueki ni yoru shinyo shuki seibun no jokyo tsuite (1)). Text in Japanese. Akushu No Kenkyu (Odor Research J. Japan), 1(3):21-28, Oct. 1970. 23 refs.

In Japan, complaints about odors are third only to complaints about air pollution and noise and in 1968 reached 19.4% of the total complaints involving these three categories of public nuisances. Although the Pollution Countermeasure Fundamental Law of 1967 clearly defined odor as a pollutant, little advance has been made in the measurement and evaluation of odors. As a result, there is no possibility of odors coming under legal control in the near future. Most of the complaints center on the collection and treatment of human excrement in cities without sewer systems, in particular on the trucks using vacuum suction hoses. Commercial deodorants are available for neutralizing and masking odors in the home and, to a lesser extent, in industry. The use of a spray deodorant containing chlorophyll for eliminating odors from the vacuum trucks was studied. Adsorbents such as activated charcoal and resins are ineffective in these cases since they rapidly become coated with water and with oil from the suction pump. As determined by gas chromatogrpahy, the chlorophyll deodorant did not completely eliminate methylamine though it effectively neutralized its odor. Fifteen peaks in the chromatogram for untreated gas were not detected in the chromatogram for treated gas, which indicated a 100% elimination. On the other hand, the post-treatment chromatogram showed 11 new peaks attributable to components of the deodorant.

26057

Shigeta, Y.

RESEARCH ON ODOR CONTROL IN THE U.S.A. (A CHAPTER OF RENDERING PLANTS IN WEST COAST). (Amerika ni okeru askushu no genjo to taisaku (taiheiyogen toshio kaseijo hen). Text in Japanese. Akushu No Kenkyu (Odor Research J. Japan), 1(3):10-20, Oct. 1970. 5 refs.

Rule 64 of the Los Angeles Air Pollution code is explained. The rule pertains to odors and applies, among others, to companies such as those making fish meal from offal and bones of tuna, those treating animal bones and carcases, and those producing feather meal from poultry feathers. Existing plants are required to use dry rendering, (indirect heating of the cooker and dryer), to suppress generation of odors. For the elimination of odors, steam in the gas exhausted from the cooker and dryer must be thoroughly eliminated by combustion of 648 C. Fish meal factories are permitted to add chlorine to the washing water. New rendering plants can use no heating process other than the cooker and must limit their use of the dryer. To encourage the adopting of modern processes and control technology, new plants are required to proces 500 tons/day to 2000 tons/day. By reducing the maintenance cost of odor-control equipment, these plants should yield higher profits. It is hoped that 99.9-99.99% odor control can be achieved.

26087

National Air Pollution Control Administration, Durham, N. C., Consumer Protection and Environmental Health Service

NEW CUMBERLAND, WEST VIRGINIA -- KNOX TOWNSHIP, OHIO -- AIR POLLUTION ABATEMENT ACTIVITY. NAPCA-Pub.-APTD-69-13, 83p., June 1969. 24 refs.

Based on air quality and meteorological measurements, levels of dustfall, fly ash, and suspended particulate matter in the New Cumberland, West Virginia-Knox Township, Ohio area are excessive. Levels of sulfur dioxide, although not consistently high, reach short-term concentrations at which undesirable effects are produced Pollution is heaviest in the area closest to a power plant, but all areas of the New Cumberland valley are affected. Topography in the valley greatly influences wind flow, limiting the ability of the atmosphere to adequately disperse pollutants. Frequent inversions, restricted lateral dispersion, and weak winds allow periods of pollutant accumulation. Undersirable effects of the pollution include reduced visibility, soiling, excessive dustfall, paint damage, vegetation damage, and irritating odors. The effect of pollution on health, as inferred by comparison of measured levels with air quality criteria, is of concern. Emissions from the power plant can be reduced by available control technology, or by the use of low-sulfur fuel combined with good combustion practices.

26125

Suzuki, Fushito

REFUSE TREATMENT BY COMPRESSION. (Assaku kokaho ni yoru gomi shori ni tsuite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 6(12):973-979, Dec. 1970.

A compression system for the disposal of city and industrial refuse was developed, able to handle 50 tons of waste in an eight hour day Consisting of sundry trash (38%), excrements (21%), synthetic resin (6%), incombustible refuse (10%), and others (25%), the gathered refuse is pressed by a preliminary and a main compression press, then covered with wire mesh to be dipped in an asphalt melt for coating. This process is carried out automatically and the resultant product, named 'Tekkaishi', is produced in about 8 minute and weighs 850-900 kg. An air curtain shuts off the foul smell fro the refuse, while the odor from the asphalt melt is improved with deodorization equipment. The water compressed out of the refuse is treated by oxidation for the removal of organic matter and is discharged Waste water is screened to be accumulated with activated [illegible]ge and is purified in sedimentation tanks. Problems connected with the adoption of an asphalt method concern the high temperatures of operation, foul odors, and the life of the melting furnace. Pollution by the 'Tekkaishi' buried in the earth has not been observed.

26128

Baba, Y.

DEODORIZING EQUIPMENT AND DEODORANTS. (Dasshu sochi oyobi dasshuzai). Text in Japanese. Kogai (Hakua Shobo) (Pollution Control), 5(2):62-81, March 1970. 3 refs.

Of the 5986 complaints received by 30 prefectural governments in 1967, 1232, or 20.6%, concerned odors. Sixty-five percent of the odors originated in agricultural and livestock operations and 45% in industrial processes, mainly those of chemical and food industries. As determined by a survey of 3000 enterprises, the mos commonly used deodorizing method is gas cleaning. The principles o which a number of odor control methods are based are described together with areas of application and equipment used. Major equipment manufacturers are noted, as are operating costs of the methods. The methods include ozone oxidation, catalytic combustion adsorption, chlorine treatment, air oxidation, combustion, and use of chemical deodorants. Ozone oxidation is mainly used to eliminat odors of human excrement; its operating cost is low. Catalytic combustion has wide application, and its operating cost is lower than that of the heat tube method. Depending on application, gas cleaning methods vary greatly in scale, type, and materials. The adsorption method is applicable to rendering plants and feed processing plants. Air oxidation is used to treat effluent containing hydrogen sulfide, and direct combustion by oil and fat industries. Thirty seven deodorants are described.

26172

Collins, T. T., Jr.

OXIDATION OF KRAFT BLACK LIQUOR -- WHERE DOES IT STAND? Paper Trad J., 146(30):39-48, July 23, 1962. 153 refs.

The literature and patents on black liquor oxidation are reviewed in an attempt to clarify the sources of original discoveries. In addition, objections to foaming-type oxidation units are noted as are the advantages claimed for new systems such as the British Columbia Research Council, modified Trobeck, Tomlinson, and Weyerhauser systems. Also reported are studies on the application of oxidation systems in sulfite recovery, studies of the economics resulting from black liquor oxidation, studies showing reduced tube corrosion by oxidized liquor, catalyzed reactions of oxygen with alkaline sulfide solutions, and procedures for analyzing oxidized liquor samples. It is noted that many mills will now be forced to install oxidation systems as one step in more complete odor control programs. Mills that are not under criticism for stream or air pollution will probably continue to operate without oxidation systems. These mills will be among those not using extra sulfur above salt cake for make-up for desired sulfidity, that do not find an appreciable cost advantage in substituting soda ash for part of the salt cake, and that do not wish to oxidize liquor merely to balance the saving of fuel for reburning lime.

26173

Guest, E. T.

RECENT DEVELOPMENTS IN BLACK LIQUOR OXIDATION. Paper Trade J., 148(12):30-34, March 23, 1964. 8 refs.

It is possible to eliminate almost completely hydrogen sulfide from kraft mill stack gases with a fully oxidized black liquor, followed by a properly loaded and operated furnace. When the definite odor reduction in the evaporator condensate is also considered, it is evident that oxidation is an essential link in overall odor control. The most prevalent oxidation techniques are the Collins system, the British Columbia Research Council system, and the Troebeck-Ahlen system. Of these, the Troebeck- Ahlen and the Collins type oxidize by forcing air through the liquor in a manner to make a controlled volume of foam. The BCRC unit operates with air blowing concurrently with the liquor over specially designed plates. Other systems are packed columns with either concurrent or countercurrent air, compressed air in a tank of liquor, or compressed air in a pipeline. A detailed discussion is presented of pilot-plant work on the Troebeck-Ahlen unit together with a summary of pilot-plant results. The data have been incorporated into the design of commercially available towers.

26176

Ghisoni, Pietro

ELIMINATION OF ODORS IN A SULPHATE PULP MILL. Tappi, 37(5):201- 205, May 1954. 12 refs. (Presented at the 7th Alkaline Pulping Conference of the Technical Association of the Pulp and Paper Industry, Houston, Tex., Nov. 18-20, 1953.)

A plant for eliminating mercaptans from an Italian sulfate pulp mill is described. The mill is located in a narrow valley, on a river with a very limited water flow, near a heavily populated area. The main operations in the odor control plant are: (1) condensation of all relief and blow gases with indirect condensers; (2) use of the condensed water as dilution water in a chlorination tower of the bleaching plant; (3) the noncondensable gases are burnt in one boiler together with natural gas; (4) the smoke from the recovery boiler is cooled to the dew point, then oxidated with chlorine and again heated to avoid corrosion in the chimney. (Author abstract modified) 26176 Ghisoni, Pietro

26254

Perrine, Richard L. and Limin Hsueh

MISCELLANEOUS INDUSTRIAL EMISSIONS. In: Project Clean Air. California, Univ., Berkeley, Task Force 5, Vol. 1, Section 14, 5p., Sept. 1, 1970. 3 refs.

Five broad categories of industrial polluters are briefly considered, as well as their kinds of emissions and control problems. The inorganic chemical industry has problems with hydrochloric acid, hydrofluoric acid, nitric acid, sulfuric acid, calcium oxide, chlorine, soaps and detergents. Steel production is a major industry, but the open hearth furnaces are gradually being replaced by the basic oxygen furnace. Although this also produces fumes, the new plants can be constructed with proper control equipment. Foundries may change the work they do from day to day so that control problems are at their worst, but methods to trap particles and fumes are available. The handling of large volumes of minerals normally involves problems with dust, while the special biological effects of asbestos must be noted. Glass fibers can also be a problem, as well as fluoride-containing ores. Copper lead, and zinc mining and milling operations involve dust problems, while sulfur oxides may be released during smelting. Hydrogen sulfide, mercaptans, sulfide and polysulfides which have very bad odors, and other noxious gases are emitted during wood pulp processing. Typical gaseous emissions from Kraft pulping are presented tabularly. Coffee roasting plants, slaughterhouses, and pickel plants emit strong odors. An areas of concern is new processes to break down waste and return it to a state useful in natural processes without problems of storage. A particularly important point which needs to be considered is site location.

26296

Okatsuka, Hisashi and Tomizo Honma

TOSHIBA ELECTROSTATIC AIR FILTER. (Toshiba kuki seijoki). Text in Japanese. Toshiba Rebyu (Toshiba Rev.), 24(1):100-106, Jan. 1969. 7 refs.

An effective method utilizing static electricity is described which removes dust in the atmosphere. By covering the positive plates with an insulator, the negatively charged plates can be brought within a distance of 1.5 to 2.5 mm to the positively charges plates thus increasing their adhesive force. The apparatus comprises a filter, an ionizing section, a precipitator, a deodorization filter and a cation generator. The first filter collects the comparativel large particles more than 5 micron in diameter. An ionizing section, which is formed by several grounded metal plates placed parallel to the air flow and by tungsten wires placed between the plates, generates a small amount of injurious gases such as ozone and nitrogen dioxide. The small distance between the negative and positive bands results in low voltage between them during operation and improves the collection efficiency and spark noise. An activated carbon deodorization filter effectively removes the injurous gases. The cation generator utilizes a method of corona discharge, while reflected light from the wall of the ionizing section is included to reduce dust accumulation. A removal efficiency of 95% can be achieved, while the smallest particles which can be removed are 0.01 micron in diameter. The number of filter units to be installed can be determined by the use of a char and a dust meter.

26308

Endo, T. and T. Okazaki

REMOVAL OF ODOR OF ORGANIC SOLVENT AND UTILIZATION OF RECOVERED HEAT BY U.O.P. CATALYTIC COMBUSTION SYSTEM. (Sesshoku sanka shokubai sochi ni yoru yuki yozai shuki jokyo to kaishu netsu riyo ni tsuite). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(3):45-53, Oct. 1970.

The U.O.P. catalytic combustion system is utilized for counteractin odors, while also recovering heat to economic advantage. It features a catalytic element made of platinum and a combustion system which preheats the gas to be treated up to the temperature at which catalysis occurs. After eliminating the odor, the gas is recycled. Examples are included for a metal printing and automobil painting factory. There are a number of variations in the system, such as the use of oxidized ethylene or nitric acid equipment. In these cases, the exhaust gas which was passed through the catalytic element in a high pressure vessel is transmitted to a gas turbine and utilized for generation at the plant. At the enamel baking furnace, color iron sheet baking furnace, or canning sheet printing furnace, the remainder of the exhaust gas which contains solvent fumes is preheated before being passed through the catalytic elemen and returned to the heat generation furnace, economizing fuel. Low concentrations of gas can be oxidized at 260 to 350 C, with the fuel cost about 1/3 of the direct combustion method. The element can easily be detached for maintenance.

26567

Kikuchi, K. and K. Wada

DEVELOPMENT OF BURNING APPARATUS DEODORIZING AND MAKING SMOKELESS. (Mushu muen nensho sochi no kaihatsu). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 22(12):25-31, Dec. 1970.

An apparatus is described which promotes the complete combustion of odorous gas and smoke generated by incinerators and rendering, fertilizer, chemical, and leather plants, thus rendering emissions odorless and smokeless. Exhaust gas is first led into the outer chamber of a heat-proof, special metal (SUS-33) combustion chamber and rapidly heated by contact with flame at 1400-1600 C to produce ultra fine particulates. Radial heat from an infrared generator is utilized for oxidation-cracking of the odorous compounds contained in the ultra fine particulates. The pre-heated and completely burned gas is then jetted to the combustion chamber where the tempeature is maintained at plus 400 C. The apparatus affords economies in the use of heavy oil required for reburning in the combustion chamber. In addition, the pre-heating of the gas permits the combustion chamber to be compact.

26568

Onishi, I.

DE. ROLL TYPE INCINERATOR. (De roru shiki gomi shokyaku sochi). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 22(12):1-4, Dec. 1970.

Based on technology developed by the von Roll Co. in Switzerland, the Hitachi Shipbuilding Co. has developed the 'de Roll' incinerator for handling garbage. The incinerator is characterized by complete combustion, even of plastics, thorough automation, low maintenance costs, ease of operation, and smokeless, odorless, and dustless incineration. The system includes combustion and postcombustion chambers and provisions for drying. Air for burning is supplied through grids, which are equipped with shredders that expedite incineration by exposing the inner unburnt portion of garbage. Exhaust gas is cooled by water jets, while soot is trapped by a multicyclone and electric dust collector. Odors are confined to the incinerator area by a negative load inside the garbage pit and by air curtains at the entrances and exists of garbage collection cars. Equipment such as the ventilator and steam condensor are made soundproof by concrete covers and sound-absorbing materials.

26618

Japan Oil Refinery Co., Negishi Works

REPORT EXPLAINING THE MEASURES TAKEN BY THE COMPANY IN PREVENTING POLLUTION. (Kogai boshi taisaku genkyo setsumeisyo). Text in Japanese. 61p., July 1970.

A description is given of the measures adopted to prevent air, seawater, and noise pollution by a refinery constructed near a residential area of Yokohama. Control measures include a green belt, the adoption of hydrogen refining, circulation of cooling water, and effluent stripping. In constructing facilities for the production of high-grade lubricating oil, stacks 130-m high were built and noise prevention devices such as closed heaters, silent fans for air-fin coolers, and water-cooled motors were adopted. The plant itself was built close to the coast and the tanks were placed nearer the residential area. The solvent tank is equipped with a deodorizer and filled with activated charcoal; the compressor is surrounded by soundproof walls and located to the side of the residential area. Ammonia and hydrogen sulfide effluent from the Isomac (?) equipment is recovered as ammonia and sulfur. Other innovations include the use of a PPI oil separator and the recovery of the caustic soda employed in washing liquefied petroleum gas for use in manufacturing soda sulfide. By the end of 1969, about 20% of the total plant investment had gone toward the pollution abatement program. When completed, the capacity of the refinery will reach 310,000 barrels a day but emissions of sulfur oxides are expected to be relatively low.

26730

Essenhigh, R. H. and T. J. Kuo

DEVELOPMENT OF PHYSICAL AND MATHEMATICAL MODELS OF INCINERATORS. PART 1: STATEMENT OF THE PROBLEM. American Society of Mechanica Engineers, New York, Incinerator Div., Natl. Incinerator Conf., Cincinnati, Ohio, 1970, p. 261-271. 18 refs. (May 17-20.)

Combustion in an incinerator occurs in two differentiated zones: the solid bed, where the principal combustion processes are pyrolysis, gasification, and combustion; and the overbed region, where the principal processes are flame holding and final burnup. Equations are developed to relate combustion intensity in each zone independently to the average combustion rate in each zone. This amplifies a previously developed equation relating the overall combustion intensity to the area firing rate and incinerator capacity. The basis for predicting limts to capacity and burning rate, by application of the thermal theory of ignition and extinction, it also outlined. The smoke-fume and odor-pollutio problem is dominated by the overbed combustion since it is here that burnout is or is not fully completed. For matching burning times to residence times, kinetic data on the reaction of the smoke during burn-up must be developed. (Author abstract modified)

26731

Biswas, B. K., T. Kuo, and R. H. Essenhigh

STUDIES ON COMBUSTION BEHAVIOR AND EXTINCTION LIMITS OF SMOKE FLAMES. American Society of Mechanical Engineers, New York, Incinerator Div., Proc. Natl. Incineration Conf., Cincinnati, Ohio, 1970, p. 304-313. 18 refs. (May 17-20.)

Smoke emission from incinerators is a result of failure of overbed burning of carbon-bearing volatiles. This failure can be complete, meaning that there is no overbed flame at all, or it can be partial, meaning either the smoke reaction is quenched before completion or else that there is inadequate mixing so that some of the smoke-bearing gases bypass the overbed flame and escape. The effectiveness of countervortex mixing for flame holding was qualitatively studied by burning smoke from pyrolyzing computer cards in a circular pipe with air injection ports arranged to produce opposed vortex flows. Kinetic constants were determined for equations governing burnout so that overbed combustion volume can be correctly sized by means of previously developed equations. The initial results reported provide support both for the flame-holding concept of the countervortex flow pattern and for the view that complex smoke can be treated as a single reactive component with operationally valid kinetic constants. The activation energy for smoke flames was 25 plus or minus 5 kcal. Calculations of extinction temperatures showed that overbed flames can be maintained at temperatures (500 F) below the generally quoted low limit for destruction of odor. Extinction temperature rose with increasing excess air, indicating the need for good feed control.

26778

NEW REFUSE INCINERATOR DEMONSTRATED IN WEST GERMANY. Surveyor - Local Govt. Technol., 135(4054):44, Feb. 20, 1970.

A German firm has invented a rotary automatic incinerator which is said to produce a completely sterile ash and to release no smoke or odors to the atmosphere. The improved efficiency of incineration is attributed to removing the need for a grate. Operating at 1150 C, the system is designed to handle all household refuse together with the waste of hospitals, markets, and abattoirs. Between one and one-half tons of refuse are burned per hr, depending on the calorific value of the materials. Cost of the incinerator without housing is less than $195,3000. The added cost of housing is about $150,000.

26836

Tsuji, M., T. Okuno, and T. Yamamoto

MEASUREMENT OF ADSORBING ABILITY FOR ODORANTS TO ADSORBENTS. (Shuk seibun no kyuchakuzai yoru jokyoritsu no sokutei). Text in Japanese. Hyogo-Ken Eisei Kenkyusho Kenkyu Hokoku (Rept. Environ. Sci. Inst. Hyogo Prefect.), vol. 1:16-18, March 1970. 5 refs.

Measurements were made of the amount of odorous gases adsorbed by active carbon and a chemical adsorbent consisting of nitro-humic acid derived from coal (MGP). Approximately 10 to 1000 ppm of ammonia, hydrogen sulfide, dimethylamine, and trimethylamine were passed, respectively, through the adsorbent bed at 2-40 m/min. Gas adsorption decreased slowly with increasing gas flow rate up to 10 m/min, rapidly decreased at flow rates between 10-25 m/min, and decreased slowly again at flow rates above 25 m/min. Within the experimental conditions, the capacity of the adsorbents was not influenced by gas concentrations. Exceptions to this observation were adsorption of ammonia on active carbon and adsorption of hydrogen sulfide on MGP.

26843

Yukawa, N.

ANALYSIS OF SOME ODOR SOURCES AND THEIR CONTROL. (2,3 no shuki hasseigen no kaiseki to sono taisaku ni tsuite). Text in Japanese. Sangyo Kankyo Kogaku (Ind. Environ. Eng.), no. 65/66:69-82, July 1968. 15 refs.

Methods for treating obnoxious odors include adsorption consisting of passing the gas through active carbon or other porous materials, scrubbers using water or chemical solutions, chemical oxidation method, masking, catalytic oxidation, and direct flame deodorization. Data showing the effectiveness of these methods are presented. The types of processes that emit odor include the phthalic anhydride manufacturing process in which the basic odor problem stems from the emission of air used for oxidation. Data ar introduced for fixed bed and fluid bed phthalic anhydride manufacturing. The best deodorization method seems to be the direc flame method, although it is still uneconomical. Odor from polyvinylchloride manufacturing processes requires combustion and dechlorination for deodorizing. The main odor source for glass fiber manufacturing is phenol, and it can be countered by the combustion method. Further discussions are presented on counteractions for odors from rendering plants, fish meal plants, halogenated hydrocarbon emission gas, enamel wire coating furnace, and furnace for cooking rubber for wire coating. A brief treatise is given on the theory of olfaction diagrams.

26908

Benger, Michael

REDUCTION OF AIR POLLUTION ARISING FROM REFINERIES. In: Pollution Prevention. Inst. of Petroleum, London (England), Proc. Inst. Petroleum, Summer Meeting, Brighton (England), 1968, p. 28-38.

When a new refinery project is under consideration, consultations are held to ensure that the anti-pollution proposals are acceptable. Statutory limits which are laid down by act of Parliament are well-established ones in which the technical possibilities by way of controlling emissions are well known. With the great majority of emissions, presumptive standards are laid down at the discretion of the Chief Alkali Inspector, and these can be altered as circumstances change. Technical feasibility, the effect on human and animal health, damage to vegetation, and odor thresholds are all taken into account. Potential nuisances include sulfur dioxide, hydrogen sulfide and mercaptans, fluorine, smoke, fuel ash, acid smuts, and noise. A major breakthrough in petroleum processing has been the replacement of the old liquid refining processes by catalytic desulfurization. Various methods used to control these pollutants are discussed, including cost factors. The Reinluft process is mentioned, as well as the Monsanto/Penelec process. The former utilizes activated carbon while the latter employs vanadium pentoxide. A dry absorption process utilized by the U. S. Bureau of Mines employs alkalized alumina to control SO2. The offensive odor of mercaptans may be controlled by stripping the condensate with steam or flue gas or both. Recently it has become common practice to use the sour condensates as wash water to crude oil desalters.

26944

Wertzler, John E.

THERMAL DESTRUCTION OF FUMES. Preprint, American Society of Mechanical Engineers, New York, Fuels Div., 9p., 1969. (Presented at the American Society of Mechanical Engineers, Winter Annual Meeting, Los Angeles, Calif., Nov. 16-20, 1969, Paper 69-WA/Fu-1.)

A number of industrial processes employing commercial solvents, including a variety of baking, drying, and curing operations performed in ovens, dryers, and kilns, are responsible for odorous discharges. A review of methods of thermal destruction of these odorous compounds is presented. The two major problems associated with fume incineration are temperature and dwell time. Several conventional types of burner designs are compared in terms of their hydrocarbon removal efficiency as a function of carbon monoxide content. The effluent can be rendered harmless (in conformation with even the most stringent air pollution codes) prior to being emitted to the atmosphere.

27154

Acres, G. J. K.

THE CONTROL OF AIR POLLUTION. PLATINUM CATALYST SYSTEMS FOR INDUSTRIAL ODOUR CONTROL. Platinum Metals Rev., 15(1):9-12, Jan. 1971. 4 refs.

Since catalytic and direct flame combustion systems completely destroy odor-creating organic compounds by oxidizing them to carbon dioxide and water, they are generally recognized as the ultimate answer to odor abatement. The development of a honeycomb platinized catalyst makes it possible to incorporate a catalyst in a combustion system without introducing the problems previously experienced with catalytic combustion systems. Noticeable among these were pressure drop across the catalyst bed, catalyst attrition, and catalyst poisoning. A honeycomb catalytic system with heat recovery is schematically illustrated. Process gases are heated in the combustion chamber and passed directly to the catalyst, which is installed in modular form to simplify installation and maintenance. By giving about 50% heat recovery, the addition of a heat exchanger ensures that odor free outlet gases are above the dew point and thus prevents condensation in the unit. This system has been successfully evaluated for the removal of odors from animal, fish, and food processing industries.

27288

Shigeta, Yoshihiro

TECHNIQUE CONCERNING THE PROCESS TO REMOVE OFFENSIVE SMELL BY COMBUSTION. (Nensho hoshiki ni yoru akushu jokyo gijutsu). Text in Japanese. PPM (Japan), 2(1):54-59, Jan. 1971. 7 refs.

Difficulties in odor countermeasures are caused by the following factors: first, impulse measurement of the sense of smell varies logarithmically with the concentration of the substance of the offensive odor. Thus, slight increase in the offensive substance is not easily sensed. The second factor is based upon the law of Weber-Fechner. A 50% removal rate of the offensive odor is scarcely perceived by the sense of smell while when a removal rate of between 99.9% and 99.99% is obtained, the decrease in offensive odor is admitted by the neighboring citizens. Third, sense of smell fatigue may become an obstacle when the concentration of offensive odor is measured or a test of the sense of smell is conducted. Fourth, the offensive odor that causes complaints of the neighboring citizens comprises multiple contents of which each has its own threshold value. Fifth, there is a great difference in each individual's sensory organ. Sixth, the evaluation of offensive odor pollution varies with areas. In connection with a combustion deodorization process, at first an odor has to go through the minimum condition of heating to 650 C for more than 3 seconds. It is not permissible for an offensive odor to go through imperfect combustion in stoking equipment. Setting two sheets of steel in stoking equipment helps to avoid such a possibility. In case oversaturated moisture and offensive odors are mixed with each other at such a high temperature in a digester used in a kraft pulp factory or in a dryer, glossal stoking equipment and an energy source are necessary to remove the offensive odor by burning. Therefore, moisture in the offensive odor has to be removed in advance before the combustion deodorization process is operated. The following process is most often adopted as effective for removing moisture: dust mixed with the offensive odor is at first removed by a cyclone. Then vapor in the offensive odor is removed because the temperature of the offensive smell is reduced until it is about 15 degrees higher than that of air. The residual vapor is eliminated by an ejecter while the residual moisture is again eliminated by an after- condenser.

27336

Carlson, Dale A. and Curtis P. Leiser

ODOR CONTROL WITH SOIL FILTERS. Trend Eng. Univ. Wash., 1965, p. 14-18, 24, Jan. 1965. 15 refs.

An economical method of removal of sewage odors, utilizing soil system processes especially adapted to volatile materials emanating from sewerage facilities, is described. Soil filters were used successfully in reducing the emission of odorous gases into the atmosphere. The experimental system described is applicable to odor problems associated with industry and with waste-water transport. The removal mechanism for soil filters is primarily biological; thus, under proper environment conditions, process efficiency does not diminish during extended time periods. Designs are suggested for economical and easily operated systems of odor removal from waste-gas streams. (Author abstract modified)

27357

Wright, R. H. and R. W. Klinck

WHAT PORT ALBERNI HAVE DONE TO CONTROL KRAFT MILL ODORS. Paper Trade J., 139(41):22-24, Oct. 10, 1955. 11 refs.

A kraft pulp mill has reduced recovery system odors with a well- designed black liquor oxidation system employing a very large ratio of air to black liquor and with a simple provision for adding digester gases to the air supply. The system uses twin oxidation towers in which the black liquor flows downward through asbestos- cement plates. The two towers are located immediately adjacent to the hot-water accumulator tank which is part of the blow-heat recovery system, and the forced air fan which supplies air to the towers draws its air through a duct connected to the accumulator tank vent pipe. When the towers are operating, their air supply is first drawn downard through the accumulator vent; when the towers are not operating, the vent pipe continues to fulfill its original purpose. In this way, noncondensible digester gases are easily mixed with the air supplied to the towers, or, alternatively discharged to the atmosphere. With the towers, the mean rate of emission during a digester blow is now 0.36 rather than 2.24 gr/sec Although the rate is still sufficient to produce a noticeable odor for a short distance downwind, both the intensity of the odor and its range are much less than they would be in the absence of the oxidation system.

27401

Leak, Robert J., John T. Brandenburt, and Milton D. Behrens

USE OF ALUMINA-COATED FILAMENTS IN CATALYTIC MUFFLERS: TESTING WITH MULTICYLINDER ENGINE AND VEHICLES. National Air Pollution Control Administration, Raleigh, N. C., Proc. Symp. Heterogeneous Catalysis Control Air Pollution, 1st Natl., Philadelphia, Pa., 1968, p. 161-173. 3 refs. (Nov. 21-22.) NTIS: PB 194169

Catalytic mufflers with an alumina-coated filamentary structure wer tested for oxidation of hydrocarbons and carbon monoxide in automotive exhaust. The catalytic mufflers were evaluated in combination with a manifold afterburner system, which warmed the catalysts rapidly and prevented them from overheating. A dual catalyst system of vanadia plus copper chromite on alumina-coated steel wool had the highest activity and the best life characteristics. However, copper chromite on the same structure was used for road tests because of superior odor of the treated bases and simplicity of preparation. On cars with large displacement engines, catalytic muffler plus manifold afterburner passed the official California cycle after 12,000 miles of operations. On a car with a small displacement engine, which emitted excessive amounts of carbon monoxide, the system did not reduce the combustives enough to pass after 12,000 miles. (Author introduction modified)

27541

Yamamura, Yoshio and Michimoto Hirabayashi

SMOKELESS, ODORLESS INCINERATOR FOR REFUSES. (Jinai no muen mushu shokyaku sochi). Text in Japanese. (Daido Enka Kogyo K. K. (Japan)) Japan. Pat. Sho 45-8948. 4p., March 31, 1970. (Appl. Dec. 3, 1966, claims not given).

An economical, smokeless and odorless incinerator is presented that can be built in a compact size according to individual need for use such as in a small factory or a household. Although in central, large-scale, incineration equipment, since the heat is often utilized for power generation, it is economical to heat generated gas to 800 C or higher in order to remove bad odors, and smoke by means of a red-hot chamber provided at the exit to the chimney stack; in a small-scale incinerator for individual use, it is not. The new incinerator for small factory or individual household use can incinerate even organic refuse without generating visible smoke or a bad odor. A dry distillation kiln is built into the incinerator. The kiln has a cover on the top side and a bottom lid, and a gas-discharge pipe on one side near the top. The gas-discharge pipe is led into the auxiliary fuel combustion chambe next to the bottom of the incinerator. This auxiliary fuel combustion chamber has a burner, a secondary air-intake port and a gas-mixing combustion cylinder equipped with spiral blades. The chimney is in the upper part of the side wall of the incinerato opposite to the gas discharge pipe, while a small air blower is installed outside of the bottom of the incinerator and is connected to the kiln through the wall by means of an air-feeder pipe. Refuse is put into the kiln through the top. As the burner in the auxiliary fuel combustion chamber is ignited, auxiliary fuel, together with secondary air taken in, burns at a fairly high temperature. Hot gas generated by the combustion goes through the cylinder into the channel formed between the inner wall of the incinerator and the outer wall of the kiln and is let out through the chimney. As the hot gas goes through the channel, the kiln is sufficiently heated to volatilize the refuse. The gas is then led into the auxiliary fuel combustion chamber through the gas-discharg pipe, mixed with burner gas there, and circulated into the gas channel of the incinerator to heat the kiln. It is then discharged thus completely deodorizing the volatilized refuse that causes the bad odor, making the smoke invisible. When gas is no longer generated in the kiln, and air, which has been heated to 400 C or higher is blown into the kiln to burn the remaining refuse therein. The combustion gas, carbon dioxide, generated in the kiln is circulated through the gas-discharge pipe, the auxiliary combustion chamber, the cylinder, and the channel to heat the kiln again and is finally discharged through the chimney.

27548

Katayose, Saburo

INCINERATOR FOR BUTCHERY AND SIMILAR WASTES. (Obutsu shokyakuro). Text in Japanese. (Assignee not given.) Japan. Pat. Sho 45-8396. 4p., March 25, 1970. 1 ref. (Appl. Sept. 20, 1966, claims not given).

An incinerator is designed to dispose of watery wastes such as butchering and fish processing wastes, including entrails, giblets, plucks, and bones of animals and fish. These wastes, produced in large quantities at a slaughterhouse or fish processing factory, are hard to incinerate, generate bad odors, and require a lot of fuel if incinerated with an ordinary incinerator. The offensive odor and the amount of smoke generated during the incineration have been serious public nuisances. The incinerator offering a solution to these problems is constructed mainly of fireproof bricks. It is divided into two main rooms by means of a brick partition wall. The larger room, the combustion room, has the firs platform projecting from the partition wall, the second platform from the opposite wall, and the third from the partition wall, in sequential order from top to bottom. The smaller room on the other side of the partition wall has a short partition wall erected on the bottom and another still shorter wall suspended under the chimney. A few flame holes are provided above the first platform on the partition wall; the flame throw-in hole is provided on the opposite wall at about the same height with the flame holes. Immediately above the third platform on the partition wall is another flame hole that is twice as big as all the flame holes above the first platform combined. Under the third platform on the partition wall is a still bigger flame hole that is twice as big as the flame hole above the third partition. This relationship is important in that it makes the main fire flames jut downward. As the watery and fat wastes thrown onto the first platform are burned by flames jetted in through the flame throw-in hole, the fat content melts and drops onto the third platform, while the water content evaporates. The flame now runs toward the next larger flam hole, growing bigger as it burns the fat content on the third platform, and heats the wastes under the first platform. The flame then goes through the largest flame hole into the other side of the partition wall where the second and third flame chambers are provided. As the flame goes repeatedly through this main path, the wastes which are defatted and dried on the first platform fall down onto the second platform and are effectively burned by the flame. Gas generated during this process is led into the second and third flame chambers where it is further burned by the flame for the complete combustion that assures deodorization of the gas.

27605

Taylor, E. F. and F. T. Bodurtha

CONTROL OF DIMETHYLAMINE ODORS. Ind. Water Wastes, vol. 5:92-94, Aug. 1960. (Presented at the Symposium on Industrial Wastes, American Chemical Society, Annual Meeting, 137th, Cleveland, Ohio, April 11-12, 1960.)

In the manufacture of Orlon, the recovery of the solvent dimethylformamide is by distillation from what is basically a two- component system of DMF and water. However, some hydrolysis occurs which forms dimethylamine and formic acid in the system. Initial practice at the May Plant in Camden, S. C. was to condense the heads and let them flow via an open ditch to retention ponds before discharging to the Wateree River, but an odor problem developed. At the May Plant where the river has a minimum flow of 200 cfs, the condensed heads are neutralized with sulfuric acid and discharged below the surface of the river. The use of a closed pipe to eliminate completely the odors that remained after neutralization proved to be necessary. At the Waynesboro Plant, the South River has a minimum flow of 25 cfs and the community's waste load to the river cannot be increased. Also, the plant is in a valley which, similar to Los Angeles, hinders the dispersion of air pollutants. Solution to this problem was achieved by a combination of direct and catalytic oxidation of the heads. Operating conditions are indicated for the catalytic unit, as well as experimental data from a pilot test.

27674

Inoue, Tatsuo

DEODORIZATION OF RANK ODORS. (Akushu no Jokyoho ni tsuite). Text in Japanese. PPM (Japan), 2(2):48-52, Feb. 1971.

Elimination of offensive smells is reviewed, and a process of low temperature deodorizing by catalyst is introduced. Substances causing odors are discussed. The features of odor substances are as follows: 1) gas or volatile substances; 2) molecular weight of 30-300; and 3) a molecular size of 3-10 A, as in chemicals such as amines, mercaptans, and such groups as nitro, nitrile, hydroxyl, ketone, aldehyde, and carboxyl. A strong odor is expected with substances containing sulfur or nitrogen atoms in their molecules. Generally, a high unsaturation of an organic compound gives a strong odor. Odors become stronger as the number of carbon atoms in a molecule increase, and the nature of the smell differs with the number of atoms. The minimum amount of odor that can be sensed is called the threshold of the sense of smell. Most rank odors substances are hygroscopic; they tend to form mist from water in the air. Natural and artificial sources of odor are considered. Deodorization methods include: 1) dilution by air (strong deodorization is from oxygen or ultraviolet rays in this case); 2) ventilation or draft (essential for indoor or basement areas); 3) adsorption (use of substances such as active carbon); 4) purification (in the case of gas); 5) combustion (at high temperature for organic substances with rank odors); 6) chemical treatments; and 7) biochemical treatments. Deodorization of large amounts requires mainly methods 5, 6, or 7. For method 5, a low concentration of odor substances requires temperatures higher than 800 C. However, low temperatures can be employed if a catalyst is used; this works in the range of 250-400 C. High deodorization efficiency is expected for the contact oxidation method. Features of this method are the lack of regeneration problems and the long life of catalysts. Several kinds of catalysts are arranged according to odor types.

27719

Hopper, W. C. and B. Rayzacher

THE IMPACT OF THE OIL INDUSTRY ON THE ENVIRONMENT, 2ND EDITION. Stichting Concawe, The Hague (Netherlands), Rept. 4/70, 19p., March 1970. 12 refs.

The environmental impact of refining operations and oil products is assessed. While super tankers represent a very great potential for pollution, the industry is generally careful to minimize oil losses during transportation--both at sea and overland. The problem of odors can be reduced by good maintenance and should gradually diminish with the introduction of modern refining techniques and engineering innovation. Many refineries are reducing sulfur dioxide emissions by recovering sulfur from hydrogen-sulfide gas streams. The sulfur-free gas is used to recover butane or for reforming to domestic gas or for the production of liquefied petroleum gas. The problems of refinery water effluent and refinery noise are complex, the former sometimes calling for biological oxidation or cooling-water recycle systems and air cooling. Noise is difficult to mask since most refinery equipment, for safety reasons, is operated in the open air. New engineering solutions must be found. With respect to petroleum products, there is already a steady downward trend in the sulfur content of fuel oils. This is due to the increasing availability of low-sulfur crudes and gradual changes in the refining pattern in response to changing demands for products.

27732

Vos, A. W. D. and J. Smarsh

AUTOMOTIVE COATINGS AND POLLUTION. Preprint, Society of Automotive Engineers, Inc., New York, 4p., 1970. (Presented at the Society of Automotive Engineers, Mid-Year Meeting, Detroit, Mich., May 18-22, 1970, Paper 700466.)

Water and air pollution which result from the various processes in painting automotive sheet metal and bodies are reviewed: cleaning and phosphate coating; spray painting and treatment of spray paint sludge; electrocoating; paint 'curing' and 'baking'; wet sanding; paint stripping; and the use of sealers, deadeners, and adhesive applications. Regulations in effect in various communities affecting these processes are briefly described; these concern control of organic and particulate emissions, opacity and odor, and water treatment requirements. Current control measures being undertaken by the Ford Co. include incinerator installations to control oven emissions, undercoating, and use of electrostatic spray equipment. In addition, several promising materials are being evaluated, such as thermosetting and thermoplastic nonaqueous dispersion enamels, higher solids solution acrylic enamels, water-based enamels and primers, and powder coatings. Material and emission testing is conducted in the laboratory; in addition, tests are conducted at assembly plants to measure exhaust or stack emissions, particularly when new materials are used in production

27793

Turpin, Alexander J.

FLARE STACK COMBUSTION TIP. (Smoke-Ban Mfg., Inc., Pasadena, Tex.) U. S. Pat. 3,547,567. 9p., Dec. 15, 1970. 6 refs. (Appl. July 22, 1968, 10 claims).

One of the most important criteria for a combustion tip is that it provide for the burning of waste gases with little or no smoke production and the substantial elimination of odors and hazardous gases resulting from incomplete combustion. In general, previously proposed combustion tips have been rather narrowly limited in the amount of waste gas which can be burned per unit time without smoke production. In most instances, the failure to provide for an adequate supply of oxygen, such as air, has been the major deficiency of the known combustion tips. The present invention provides a new and improved flare stack combustion tip. Complete drawings of the tip are given. Large quantities of waste gases may be rapidly burned with little or no smoke production and the escaping of odors and hazardous gases to the atmosphere during the burning of waste gases is substantially alleviated. A continuous flame is provided with a significant reduction in fuel requirements as compared to conventional combustion tips; waste gases are readily ignited on exciting the combustion tip regardless of wind velocity and direction, and a substantially fixed flame stand-off from the exit of the tip is provided. The proposed flare stack combustion tip requires fewer pilot lights and allows an arrangement resulting in longer life for the pilot lights. Also, i comparison with present tips, the proposed flare stack combustion tip remains cooler during combustion of waste gases, thereby reducing metal deterioration due to high temperatures. The proposed flare stack combustion tip is constructed with a centrally disposed gas conduit which has an opening in the lower end for communication with a flare stack. The upper end of the stack is at least partially closed and has a plurality of spaced apart gas conducting channels extending outward from the gas conduit, in open communication along one end with the conduit. There is a gas emission orifice in an upper segment of each of the gas conducting channels, extending substantially the entire length of the upper segment. These orifices are disposed radially with respect to the axis of the gas conduit.

27818

Westall, George B., Jr.

AIR POLLUTION CONTROL--IT'S NOT ALL BAD½ CHAR-BROILING-RESTAURANT. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 13p., 1970 (Presented at the Air Pollution Control Association, Annual Meeting 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-71.)

Char-broiling restaurants emit a dense smoke which is a fine aerosol mist of organic fat that carries a distinct odor. Not only do they present an external problem, but great amounts of grease are deposited throughout the ductwork of the exhaust system. Thus, these ducts are a concern as a possible source of fire and damage. The most effective method of control is through the use of an incineration system, as filters and water wash scrubber have not removed the aerosol grease particles to any degree of success. With proper temperatures and retention time, all odors and fumes are converted to carbon dioxide and water vapor. Excellent flame patterns are experienced with gas pressures of a 5 inch water column installed within air ducts having velocities of 2500 to 3000 feet per minute. Measurement of the exhaust air volume is a most important design consideration. Oxygen requirements are mentioned, as well as design features of the combustion and retention chambers A high temperature fan must be incorporated within the system to withstand the high exhaust temperatures from the retention chamber. Incineration of char-broiling restaurant odors and fumes will require capabilities of producing a flame retention temperature of 1000 F for 0.3 second.

28047

Fabuss, Bela M. and Wilson H. Dubois

CARBON ADSORPTION-ELECTRODESORPTION PROCESS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 18p., 1970. 1 ref. (Presented at the Air Pollution Control Association, Annual Meeting 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-68.)

Benzene was adsorbed from an air stream saturated with benzene at 20 C, and sulfur was adsorbed from an air stream containing 1.2 to 1.3 volume percent sulfur dioxide. Desorption of the adsorbate fro the adsorbent was accomplished by passing an electric current directly through the electrically conductive adsorbent bed. Resistivity of the bed depends on the activated carbon used, its particle size, and packing characteristics of the bed. More than 80% of the benzene introduced into the adsorber was recovered in liquid form using a condenser cooled with tap water, while the electric power passed during desorption was 4 kWhr/cu ft carbon bed, heating the bed in about 5 minutes to 360 C. A unit recoverin one pound of organic vapor will have a bed volume of about 0.1 cu f and the electric power cost will be about 1.6 to 2.0 cents per pound liquid product. This organic vapor recovery technique would be generally applicable to hydrocarbons, solvents, and odorous materials. In the first experimental run, 64% of the adsorbed SO2 was removed when the temperature was increased in about 7 minutes to 450 C, and the subsequent desorption was carried out at about 500 C. Only 56% SO2 was removed in the next run when the heating was maintained at a level that gave a 300 C desorption temperature for about 15 minutes and then increased to about 420 C. Costs are also indicated for sulfur dioxide processing.

28108

Rayzacher, B.

PETROLEUM REFINING AND UTILISATION: EFFECTS ON THE ENVIRONMENT. (Le reffinage et l'utilisation du petrole et l'environnement). Tex in French. Ann. Mines, (Paris), no. 11:45-54, Nov. 1970. 11 refs.

The energy consumption of Western Europe in 1965 amounted to 7.9 trillion kcal. It is estimated that this figure reached 9.4 trillion in 1970 and will be 15 trillion in 1980. In recent decades, petroleum has been replacing coal as a source of power. In 1965, 45.3% of the power used came from coal, and 42.4% from petroleum products. By 1980, it is predicted that petroleum will be the source of 58.8% of the power, and coal only 13.7%. During the same period of time, nuclear power is expected to increase from 0.7% to 10.4%, the latter figure corresponding to an output of 100,000 MW from nuclear generators in 1980. Figures are given of the number of petroleum refineries in Italy, West Germany, France, Great Britain, the Netherlands, and Belgium, together with their total production capacities. The average capacity of the European refinery is 3.73 million tons per year, slightly above that of the United States. The Pernis refinery in the Netherlands, the largest in the world, produces 25 million tons per year. A study of pollution due to escaping odors, in which half the European refineries participated, found that about 85% or more of such odors escaping from storage tanks could be eliminated by proper maintenance of pipe connections. The distillation units are an important source of odors, a condition that can be corrected by installing condensers in new plants, while in existing plants the situation can be improved by the installation of screens and by the extracting and burning of gases that cannot be condensed. A number of industries have sought a solution to sulfur dioxide pollution by building high smokestacks, 150 meters or more in height. One recently installed European plant built a chimney 213 meters high, costing 4.6 million dollars, which receives the combustion fumes from 24 furnaces and 14 boiler plants. Proper adjustment of carburetor and ignition by individual automobile owners would reduce air pollution from automobile exhaust by as much as 50%. The estimated cost of a new antiknock additive to replace tetraethyl lead in gasoline is 2.1 cents. It has been estimated that Africa alone contains sufficient low-sulfur petroleum sources to meet all the needs of European consumption.

28118

Kranig, Lothar E.

THE EXPANSION OF THE CALTEX REFINERY AT RAUNHEIM. (Der Ausbau der Caltex-Raffinerie in Raunheim). Text in German. Erdoel Kohle (Hamburg), 23(12):793-798, Dec. 1970.

The recently (1970) completed plant capacity expansion of the Caltex refinery at Raunheim included the erection of a second distillation plant for crude oil for 240 cu m/h Lybian oil, a steam cracking plant for the production of 250,000 tons of ethylene per year, a plant for the purification of propylene which is subsequently processed in Hoechst to poly propylene, three 100 t/hour boilers, a water cooling system, and the necessary storage tanks. To cope with the increased waste water output, special canal systems were built for oil free and oil contaminated waste water. A second complete oil water processing plant was erected including an oil separator (API), a rain water storage tank, a flocculator, and a two-step biological purification plant (Lurgi). The flocculator uses iron sulfate as a flocculating substance. The API separator is enclosed which minimizes the emission of offensive smelly substances. An acid stripper takes care of the removal of hydrogen sulfide, ammonia, and other offensive substances from the waste waters. Air pollution is minimized by the erection of a 135 m high stack and by the use of low sulfur heating oil. A sulfur dioxide monitoring device continuously measures SO2 emission by the stack. The emission through evaporation of offensive hydrocarbon compounds is minimized by thermal oxidizers and by storage tanks with floating roofs.

28146

Yanagi, Fusao

DISPOSAL OF SEWAGE SLUDGE INCINERATION ASH OR THE LIKE. (Gesuidodei tono shokyakubai no shorihoho). Text in Japanese. (Ishigaki Machineries Co., Ltd. (Japan)) Japan. Pat. Sho 45-39317. Dec. 10, 1970. (Appl. Aug. 15, 1966, claims not given).

An effective disposal method for the ash produced from incineration of sewage or industrial waste sludge is described. In the dewatering or dehydration of sludge or the like by means of a vacuum filter, coagulants such as iron chloride or iron sulfide and slaked lime are generally added to the sludge to cause flocculent masses to form. Thereafter the sludge is filtered to remove the solids and incinerate them. However, ash is produced in large quantities as a result of the incineration, while bad odors and poisonous gases are also generated when heavy oils or the like are utilized as auxiliary fuel. In the present method, sludge treated with coagulants and filtered for dehydration is incinerated at 800 C or higher. By means of a cyclone, the ash is separated into that chiefly composed of calcium oxide and that composed of ferric oxide. The CaO is recovered and used as coagulant to induce flocculant masses to form in the sludge to be filtered; the Fe203 ash is mixed with water and used as a reaction agent for hydrochloric acid and sulfurous acid gas generated from the incinerator, thus forming iron chloride. The solution is then separated into solid and supernatant. Only the acid supernatant containing iron is recovered and utilized as a coagulant for the raw sludge.

28206

Aikens, A.

DESTRUCTION OF ODOURS. In: Gas Purification Processes. G. Nonhebel (ed.), London, George Newnes, Ltd., Chapt. 11, Part B, p. 456-468. 25 refs.

The design and operating features of the Oxycat oxidation catalyst system are reviewed. This system eliminates odors and other objectionable characteristics of process waste gases by oxidizing the combustible materials over platinum-coated porcelain rods at temperatures far below those required for direct flame incineration. The limiting temperature range through which the Oxycat functions is from 500-1800 F (260-982 C). The system is also used to obviate deposition of inflammable condensates in dust, thus reducing fire and corrosion hazards as well as maintenance costs, and to convert the chemical energy of process exhaust gas to useful heat.

28756

Tohata, Heiichiro and Seitaro Kato

THE TREATMENT OF THE WASTING GAS BY THE COMBUSTION OF PVC COATING WIRE. (Enbi hifukudensen no nensho ni yori haishutsu suru akushu no jojyoho). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):169, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

Catalytic methods of deodorizing waste gases from the combustion of polyvinyl chloride were investigated. Polyvinyl chloride for electric wire insulation was combusted in an electric oven at 350 C. The gas was then scrubbed with water to remove hydrochloric acid, and the resulting gas was brought into contact with the following catalysts: active bauxite containing active alumina and iron oxide; alumina; and stainless steel. The strength of odor before passage of the gas through the catalytic layer was 2500 - 5000; for all types of catalysts, the odor was considerably reduced The effectiveness was in the order of bauxite, alumina, and stainless steel. The good result obtained with bauxite is apparently due to the catalyst's iron oxide content.

29131

Okuno, Toshihide and Masahiko Tsuji

ON THE REACTIVITY OF AMINES WITH OZONE. (Aminkagobutsu to ozon no hannosei ni kansuru kenkyu). Text in Japanese. Hygo-ken Eisei Kenkyushu Kenkyu Hokoku (Rept. Environ. Sci. Inst. Hyogo Prefect.), no. 2: 1-5, March 1971. 3 refs.

Oxidation with ozone removes the offensive odor due to amine compounds. At the same time, in order to eliminate the ozone's toxicity, it must be removed from the reaction system. To estimate the optimal conditions for the reaction with ozone, the reaction rate constant (K) and the free energy of three amine compounds (monomethyl amine, dimethyl amine, trimethyl amine) were measured. The ozone-amine gas reaction was carried out under a flow system using tubular reaction apparatus at constant temperature and flow volume (500 ml/min). To determine reaction order, experimental data was inserted into the different integrated rate equations until K was found. The concentration of amines and ozone ranged from 20-50 times 1,000,000 mole/l to 4-5 times 1,000,000 mole/l, respectively. The reaction rate constant (l/mole and free energy (Kcal/mole) of amines at 20 C were as follows: MMA (monoethyl amine) 0.161 times 10,000 l/mole and 4.88 Kcal/mole, DMA (dimethyl amine) 3.340 times 10,000 l/mole and 8.41 Kcal/mole, TMA (trimethyl amine) 1.380 times 10,000 l/mole and 12.57 Kcal/mole In the reaction of DMA at 28.75 times 1,000,000 mole/l with ozone at 4.35 times 1,000,000 mole/l at 10 C, the residual volume of ozone was zero when the reaction time was more than 2.25 seconds. These results play an important role in the structure of a deodorizing apparatus. The linear velocity in the ordinary gas ducts of factories is more than 1 m/sec. Therefore the contact time of ozone in the presence of MMA requires more than four seconds and a reaction tube of larger than four meters.

29251

Weston, Roy F.

FLUIDIZED BED DISPOSAL OF SECONDARY SLUDGE HIGH IN INORGANIC SALTS. American Society of Mechanical Engineers, New York, Incinerator Div. Natl. Incinerator Conf., Cincinnati, Ohio, 1970, p. 79-80. (Discussion, p. 17-21.) (May 17-20.)

Pilot-plant studies were conducted of the feasibility of fluidized-bed incineration of excessive activated sludge containing a combination of inorganic salts (calcium carbonate, calcium chloride, calcium sulfate, and sodium chloride). The fluid-bed incinerator tested was capable of both agglomerative and nonagglomerative operation. The first method involves a sand bed, the second a bed formed from the inorganic salts in the sludge. Pilot tests indicated virtually complete organic destruction without odor problems at bed temperatures between 1300 and 1500 F. Both systems of operation seemed acceptable. Based on the pilot-plant data, an incinerator was designed to handle 15% total solids and to burn 12,000 lb/day of dry solids. The system include provisions for separating particulates entrained in reactor gases in a cyclone. Fine solids from this cyclone can be discharged to a quench tank and from there transferred to a lagoon as inorganic ash, or they can be recycled to the reactor. The former mode represents the nonagglomerative mode, in which the start-up sand with subsequent makeup will always be the bed material. The recycle could be used to agglomerate the naturally fusing salts and thus to form a bed of particulate salts. Stack gases leaving the cyclone pass to a venturi scrubber guaranteed to limit stack emissions to less than 0.1 grains particulate matter/dry standard cu ft adjusted to 12% carbon dioxide.

29261

Anderson, Leonard W.

ODOR CONTROL IN RENDERING BY WET SCRUBBING--A CASE HISTORY. Preprint, Carolina By-Products, Inc., Greensboro, N. C., 7p., 1970 (?).

Chemically basic odors (e.g., ammonia and amides) at a rendering plant are successfully scrubbed with a weak soda ash solution in 60,000 and 100,000 cfm spray scrubbers. All wetted parts of the scrubbers are 304 stainless steel. Polyvinyl chloride piping and polypropylene nozzles are used. The 60,000 cfm scrubber sprays about 300 gpm of solution at 15 psi through 200 spray nozzles; the 100,000 cfm unit pumps at 450 gpm through 300 nozzles. Operating costs of the scrubbers are minimal and installed costs were low: 65 cents per cfm for the 60,000 cfm scrubber and 60 cents per cfm for the larger unit. Because of the satisfactory performance of the scrubbers, the company will prematurely retire the incinerators formerly used for controlling odors.

29278

Alferova, L. A. and G. A. Titova

OXIDATION OF SODIUM SULFIDE AND MERCAPTIDE IN BLACK LIQUOR. Bumazhn. Prom. (Moscow), 41(10):5-6, Oct. 1966. Translated from Russian by Brenda Jacobsen, Washington Univ., Seattle, Dept. of Civil Engineering, 11p., Oct. 31, 1970.

To determine optimum conditions for black liquor oxidation, aqueous solutions of hydrogen sulfide, methyl mercaptan, and their salts were oxidized by aeration at various flow rates and temperatures and within a wide range of pH. For all solutions, the rate of oxidation was determined mainly by temperature and area of contact between the solution and oxidizing agent. Both hydroxone and hydroxyl ions had a catalytic action on the rate and mechanism of oxidation. To achieve a large contact area, aeration should be carried out in an atomizing-type apparatus. Temperature should be 80 to 100 C and pressure 4 to 5 kg/sq cm. Under these conditions, the rate of oxidation is determined by the value of the pH and of the ionic salt of the black liquor. The final pH must not be lower than 12.5, as at a lower pH other oxidation products (thiosulfates, sulfites, polythionates, etc.) predominate. The oxygen consumption under optimum conditions is approximately equal to theoretical calculations. (Author abstract modified)

29323

Avery, Robert H.

COST EFFECTIVE AIR FILTRATION. Heating, Piping, Air Conditioning, 43(4):112-116, April 1971. 4 refs.

Air filtration removes particulate material and gases that may be either odorous or corrosive. Air filters are used to protect mechanical equipment, especially systems involving heating and cooling coils with closely spaced fins, to protect the product, to eliminate duct cleaning costs, and to keep interiors clean. The National Bureau of Standards has established a definition for filter efficiency. Since efficiency is tested by the dust spot method, it is defined by the ability of the filter to remove the staining portion of airborne particulates from atmospheric air. Arrestance is the weight removal of an injected standard dust. Air filters include electronic air filters, roll filters, extended surface filters, and combinations of two filters. Criteria for choosing the proper filter include efficiency, required face velocity, required pressure drop, available in-line space, and required filter life. Also, the owning and operating costs must be considered in the final selection. Because filter requirements change, many filters have the ability to be easily converted. Other ways to reduce air filtration system costs include the use of manometers, prefilters, dynamic loading, and an underrated filter. For reasons of economy and convenience, more emphasis is being placed on the systems approach. Filters can also remove odors; usually acid gas filtration using activated charcoal is most effective. If dust concentrations are too heavy for a filter, a dust collector should be used, except in the case of coarse particles and fibers, where a self-cleaning filter with a vacuum cleaning system may be more economical.

29363

Fattinger, V.

CLEANING OF WASTE AIR FROM CHEMICAL PLANTS THROUGH SCRUBBING WITH VARIOUS FLUIDS. (Reinigung von Abluft aus Chemie-Werken durch Gaswaesche mit verschiedenen Fluessigkeiten). Text in German. Chem. Ing. Tech., 43(7):426-431, 1971. 11 refs.

Chemical plant waste air having a temperature of 15 to 30 C and containing various quantities of acidic vapors, amines, and odorous dusts is cleaned in a scrubbing tower with a height of 9 m and a diameter of 1.2 m. Three scrubbing stages are arranged atop each other; each stage has its own container for the scrubbing fluid, a pump, nozzles, and return pipes. On intermediate floors are 10 circular gas inlets with a diameter of 20 cm. The ring stacks rise above these openings. Diluted sulfuric acid is injected into the gas flow. The mixture of atomized sulfuric acid and gas flows through the apertures in the ring stacks. Above the ring stacks, nozzles for a downward directed jet flow are installed. The total injected volume of scrubbing fluid at each stage is 3 cu m/1000 cu m gas. After scrubbing with sulfuric acid, the gas flows to a droplet separator and to the second stage where it is scrubbed with sodium lye. The scrubbing fluid at the third stage is selected according to the type of dirt in the gas. Usually 3% hydrochloric acid suffices to obtain an odorless gas. The total pressure loss between inlet and outlet of the scrubber is 550 kg of force per square m. One ring stack consists of 30 to 50 rings. Through deflection over the hairpin-like edges of the rings, an intense contact between scrubbing fluid and dirt in the gas is achieved.

29437

Terao, Kunio, Seiji Miyagi, and Takashi Mitadera

EXHAUST GAS PURIFICATION DEVICE FOR DIESEL ENGINE. (Dizeru kikan n kaiki joka sochi). Text in Japanese. Preprint, Japan Society of Mechanical Engineering, Tokyo, 3p., 1970. (Presented at the Japan Society of Mechanical Engineering Conference, 805th, Tokyo, Japan, Nov. 19-20, 1970, Paper 27.)

The diesel engine emission gas purifier, developed through a practical application of Core formation theory, is discussed. The purifier consists of an evaporator containing water, a cooling pipe, a condensation water tank and a polyurethane filter. Emission gas discharged from the diesel engine is taken from the exhaust gas pipe into the evaporator, in which the larger carbon particles are removed where water is evaporated with the exhaust gas heat. The exhaust gas, now containing almost saturated steam, goes into the cooling pipe, which is air-cooled with ambient air of 3 m/sec wind velocity blown by an air fan. Cooled in the cooling pipe, the exhaust gas, containing the saturated steam, becomes supersaturated and liquefied. Since core formation of water drops is most likely to take place on surfaces of the carbon particulates during this process, water drops chiefly form on the surface of the carbon particulates which are used as its core. Eve small particulates thus expand with water drops to become larger in size and then go into the polyurethane filter, where they are easily arrested. The exhaust gas, thus removed of the soot and other particulates, is then discharged from the filter into the atmosphere. Measurements made to verify effectiveness of the devic have indicated that: smoke dust removal efficiency is more than 80%; about 70% removal efficiency for sulfur dioxide and bad odor obtained with use of water alone can be increased to 100% when about 0.3% NaOH is added to water; NO2, NCHO, CH3CHO, and CO are inclined to decrease but definite confirmation of the decrease was not possible because they existed in extremely small quantities fro the beginning; water consumption is roughly 400 g/ps.h or about twice as much as fuel consumption; and loss in developed power of the engine is negligible. The purifier could be made in a practica sense, in that the one designed for a 10-litre, 190 ps diesel engin was used in an 8-ton dump truck weighed about 170 kgs.

29448

Nishida, Konosuke

THE REMOVAL FOR THE STINKING COMPOUNDS BY SPRAYING THE DEODORANT SOLUTIONS (II). (Dasshueki ni yoru shinyo shuki seibun no jokyo tsuite). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(4):21-32, March 1971. 6 refs.

At the human manure treatment plants, (with 14-300 cu m/day capacity; 30-70.5 cu m tank volume; 14-265 cu m/day charge), solid adsorbents are used to eliminate the odor and to desulfurize. Their effectiveness rapidly decreases after a few days, although at first it was 58-78% effective. Therefore the deodorant effectiveness was tested in a laboratory. Diethylamine, hydrogen sulfide, and ammonia were used as obnoxious odors. When the deodorant was sprinkled over dimethylamine, diluted to 10 times, no amine was detected when the odor source was 800 ppm and 1000 ppm. The detection range was approximately 0.01 ppm. As the odor source is stirred up by rotating wings, and contacts the deodorant, the effectiveness improves greatly. When the deodorant is sprayed at more than 0.85 ml/sec, the odors were eliminated even more efficiently. Hydrogen sulfide and ammonia odors, the main constituents of manure odor, were measured when the source concentration of ammonia was 40 ppm (2.0 cu m/min), 45 ppm (4.7 cu m/min), 50 ppm (2.0 cu m/min), 60 ppm (5.6 cu m/min), and 100 pp (2.0 cu m/min), and the amount of deodorant sprayed at 17.5, 28.0, 50.0, 77.5 and 108.0 g/min. The revolution of rotating wings was 100 ppm. As the ammonia increased, the concentration in the exhaust air decreased to 10-20 ppm, and when the amount of spray reach 108.0 g/min, the concentration in the air decreased to 2.0-4.0 ppm. Irrespective of the source concentration and treated air amount, when the deodorant spray in the air reaches a certain range, the elimination of ammonia is influenced by the time of contact between gas and liquid. The maximum was 2-4 ppm at 13.5- 37.8 sec. With hydrogen sulfide, as the deodorant increased, the concentration of odor in exhaust decreased greatly, but when the spray exceeded 45.0 g/min, the concentration in the exhaust decreased more slowly. When the spray reached 65 g/min, as in the case of ammonia, the concentration of hydrogen sulfide in the exhaust gas became 20-30 ppm, which is the limit of elimination with a 31.5-37.8 second stay in the tank. The masking method is simple to handle, requires a simple device, and causes no change in the deodorizing effect when used continuously. Eleven deodorants were tested. When analyzed, using a PEG column 14-48 peaks were detected, of which 3.16-21.75% were effective elements. The deodorant is stable up to 40 C. The spray method was much more advantageous than other methods.

29533

Terao, Kunio

EXHAUST GAS CLEANER FOR DIESEL ENGINES. (Dizeru kikan no haikijoka sochi). Text in Japanese. Nainen Kikan (Internal Combust. Eng.), 10(109):117-120, April, 1971. 4 refs.

Diesel engine smoke consists primarily of porous carbon particulate of 0.1-10 micron size which are accompanied by sulfur dioxide and benzpyrene, a carcinogenic substance. The most dangerous to human health are carbon particulates ranging from 0.5 to 2.0 microns in grain size which are likely to be deposited in the lungs when inhaled. These particulates are too small for a filter to remove and too light for a centrifuge to separate. For an electric dust collector, the exhaust gas from a diesel engine is considerably moist and contains too much soot and dust. These particulates can be made larger for easier removal by means of a thermodynamic method developed from the nucleus formation theory. When the temperature of the gas saturated with steam is lowered to produce a state of supersaturation, the nucleus formation of water begins to take place; water drops are formed. This process was theoretically analyzed and evaluated for practical application using the formulas developed by J. P. Hirth, et al. for the probability of nucleus formation. The exhaust gas from the combustion chamber of a diesel engine goes through the water in the evaporator of the cleaner wher the water is evaporated with the heat of the gas. The exhaust gas now saturated with steam, flows through a cooling pipe and becomes supersaturated. In this state of supersaturation, water drops take dust particulates to form nuclei. The water drops are then arreste as the exhaust gas goes through the filter, and is cleaned. The liquefied water returns through a pipe into the evaporator. The cleaner can remove 95% or more of the soot and dust and sulfur dioxide is also almost completely removed. About 70% of the formaldehyde is removed; carbon monoxide and nitrogen oxides are partially removed; and bad odors are almost completely removed. The exhaust gas as well as noise is remarkably reduced. This device results in no loss in the power of the engine.

29601

Shigeta, Yoshihiro

ODOR TREATMENT AND ITS COST AT RENDERING FACTORIES. (Kaseijo no akushu shoriho to sono hiyo). Text in Japanese. PPM (Japan), 2(5):78-85, May 1971. 6 refs.

At rendering factories, the raw material should be placed in a concrete pit, 2-3 m underground, with a V-shaped bottom. At the bottom, a screw conveyor is installed through which the raw materia is sent to the crusher. The pit can be equipped with a lid. Although a stone separator and metal detector can eliminate stone, gravel, and metal, such things as vinyl, cloth, and rope have to be eliminated by hand. Dead animals, animal bones, and large fish, ar put into the hasher before they are put in a cooker. These machine save labor, and the processes can be air tight. The continuous cooker is operated at 80-90 C for 10-20 minutes for fish offal. Animal bones and feathers are placed in a dry rendering plant. After cooking, a screw press removes 30-35% of the water from the fish offal and the fish cake is dried. The water is desludged. The animal bones and feathers are dried to decrease their water content to 6-10%. If an expeller is used for the fish offal to decrease the water content to 45-55%, the odor is decreased. The water removed from the offal should be utilized as fish soluble, as it contains 3-6% protein. The odor can be treated by combustion, activated coal, ozone, or oxidation catalyst methods, a neutralizer or masking method, or dilution. The cost of these methods is calculated.

29628

LAW-MAKERS SAY: CLEAN UP OR SHUT DOWN. Can. Chem. Process., 55(4):47-50, April 1971.

The major push by the Canadian government to control air pollution will surely come once Parliament approves Bill C-224, the Clean Air Act. Under the Act, air polluters may be fined up to $200,000 per instance of violating one or more of the emission standards to be set by the Federal government. Also, the Act will empower federal authorities to fine any pollution source regardless of location; this is a major departure from current federal/provincial division of powers. Controlling the fumes from coking is mentioned, as well as regulations pertaining to the emissions from petroleum refineries, lead-in gasoline, automotive emissions, and aircraft exhaust smoke. Processes for the removal of sulfur dioxide are listed tabularly. The British Columbia government has offered a prize of $250,000 for the first individual or company to come up with a device to eliminate air pollution and odor of pulpmills.

29745

Sawatani, Tsugio

PROBLEM OF OBNOXIOUS ODOR IN INDUSTRIAL POLLUTIONS. (Sangyo kogai ni okeru akushu mondai). Text in Japanese. Preprint, Association of Safety Engineering, Yokohama (Japan), 24p., 1970. (Presented at the Association of Safety Engineering Seminar, 17th, Yokohama, Japan, Feb. 1970.)

Among the causes of obnoxious odors from industry are hydrocarbons, and mercaptan from oil refineries, mercaptan, from paper and pulp mills, and amines and fatty acids from rendering factories. Small local sources include plants which house and process animals (fisheries, pig sties, poultry houses), and garbage incineration plants. The kinds and intensity of odor are very vague, subjective, and difficult to classify. Weber-Fechner's law is explained, as well as fatigue from smelling, individual differences, and molar olfactory. Gas chromatography is generally used for measuring odors, although the gases which constitute the odors in the atmosphere must be condensed before they are analyzed. Other methods of measuring odor concentration include air dilution and saline water balance. Methods to eliminate odors are washing, cooling (condensation), adsorption (activated coal), air dilution, addition of such chemicals as acids, alkalis, chlorine, or ozone, and combustion (re-combustion, contact oxidization). Venturi scrubbers and towers are effective for trapping odors. Condensation is effective when odorous gases are at high temperatures and contain steam. Activated charcoal is expensive and if the charcoal is to be reused, the odor must again be eliminated. Air dilution requires a few hundreds or a few thousands times of air and at present is not feasible. Washing is successful if it can eliminate 90% of the odor. The use of acid or alkali instead of water is more effective. Waste liquid disposal again presents a problem and the facility itself is costly with high operating expenses. Recently, a mixture of acidic and basic powder was sprinkled on poultry droppings to eliminate odor. Ion-exchange is a combination of the acid-alkali and adsorption methods, but still is costly to maintain. Chlorine and ozone are not practical. Recombustion in a rotary drier would break down odor at 700 C. Contact combustion uses platinum catalytic wire net kept at 350 C, but the gas should not contain dust. If this condition is met, the method may have possibilities.

29761

Smaller Enterprises Promotion Corp. (Japan)

ON PUBLIC NUISANCE BY, AND ENVIRONMENTAL HYGIENE OF, PAINT MANUFACTURING INDUSTRY. (Toryo seizogyo, kogai kankyo eisei ni tsuite). Text in Japanese. Rept. 417, p. 40-41, March 1971.

A survey was taken on public nuisances in small enterprises. In the paint manufacturing industry fire hazards received 32.9% of the complaints and guidance by the supervising governmental offices bad odors received 28.2%. Other items in the list were effluents, smoke, noise, traffic noise and danger, and dust. Enterprises with a work force of 50-99 persons headed the list with 24 cases, followed by those with 30 persons or less with 22 cases. Of the 28 cases of fire hazard grievances, 20 cases have been corrected by improving the production facilities (17 cases) and by other corrective measures (three). Eight still remain incorrected. The reasons given for the pending corrective actions were that the preventive devices and facilities cost too much (one case), or that the factory space was too limited to spare extra space for installation of the preventive devices and facilities (seven cases). Also, 22 of 24 odor grievance cases were solved by equipment improvement (16), change of blended material (two), stoppage of the production of those products causing public nuisances (six), and other measures (two). Two cases still were uncorrected due to the lack of knowledge of what to do about the solution (one), and the cost of preventive equipment (one). The devices and equipment installed to improve the working environment were shown by purpose. Of the 85 enterprises surveyed, 17 had the heating/cooling facilities, 26 the deodorizing facilities, 30 the dust-removing, 69 the ventilating, and 18 the soundproofing.

29877

Elliot, Thomas C.

ODOR CONTROL: ITS TIME IS COMING. Power, 115(6):S 12-S 13, June 1971.

Leading industrial odors, their sources and means of control are identified. Unlike the situation existing in most phases of pollution control, effective measures abound for odor abatement; but analytical limits are still in a state of flux due to the questionable nature of odor-measurement techniques. This long-standing deficiency will be corrected, probably within a year, when the Environmental Protection Agency releases recommended limits for a broad range of obnoxious pollutants. Local ordinances, moreover, are becoming more specific and quantitative, defining excessive odor intensity in several instances in terms of the number of volumes of odor-free air required to dilute one volume of odorous air to unobjectionable levels, and rating as unacceptable any odor found objectionable by a percentage (usually 30%) of people exposed to it. The odor control methods discussed include combustion, absorption, ozonation, masking and counteraction. Advantages of each method are indicated.

29978

Okuno, Toshihide and Masahiko Tsuji

ON THE REACTIVITY OF AMINES WITH OZONE. (Amin kagobutsu to ozon no hannosei nikansuru kenkyu). Text in Japanese. Hyogo Prefecture, Kobe (Japan), Environmental Science Inst., Rept. 2, p. 1-5, Feb. 1971. 3 refs.

The unpleasant odor of most of aliphatic amines with basicity stronger than ammonia was removed by oxidation ozone. Because of its toxicity, ozone must be completely used in the reaction. The reaction rate constant (K) and activation energy (E) were measured for the gas-gas reaction of monomethyl, dimethyl, and trimethyl amines with ozone. Because of the high reaction rate, a flow system using a vinyl chloride tubular reaction apparatus at constant volume and temperature (20 C) was employed to reduce the contact time to as low as 0.25 sec. The reaction rate constant ranged from 0.161 times 100,000 to 3.340 times 100,000 l/mole, and the activation energy from 4.88 to 12.57 Kcal/mole. To determine the reaction order, a first-order reaction was first assumed and th basic equation integrated. The experimental data was inserted into the equation; the assumption failed to give the measured value for the reaction rate constant. By way of a similar procedure, the reaction was second order until 3.5 sec of the reaction time. Since the flow velocity in the exhaust ducts of factories is normally above 1 m/sec, duct length of over 4 m is required to realize the contact time over 4 sec. The reaction rate of ozone decomposition by vapor or heat needs further studies.

30062

Davis, John C.

PULPERS APPLY ODOR CONTROL. Chem. Eng., 78(13):52-54, June 14, 1971.

Total reduced sulfides from the pulping industry, composed mainly of hydrogen sulfide, can be detected by the human nose at a concentration of 1-5 ppb. To get below the threshold for smell at ground level, the stack concentration of total reduced sulfides cannot be much more than 1-5 ppb. To reduce H2S emissions, Babcock and Wilcox has designed out the evaporator. The three main design changes in the recovery boiler are: an increased reliance on forced circulation of liquor through the exchangers; a revised tube-surface arrangement to offset sealing and poorer rates of heat transfer; and a steam pressure limit of 35 psig coming into the multiple-effect train. The Combustion Engineering Corp. offers five recovery boiler designs that can be tailored to fit a specific pulpmill. Despite its economy, oxidation has been abandoned in many pulpmills in the southern U. S. due to excessive foaming in weak black liquor. However, the tonnage oxidation system, operated by Owens-Illinois, reportedly has solved this problem; a 94-97% efficiency is claimed in converting sulfides to thiosulfates. Western Kraft Corp. has introduced another type of stack gas cleaning, namely, scrubbing with a weakly alkaline wash liquor.

30124

LEAD SMELTING PLANT CONTROLS AIR EMISSIONS. Environ. Sci. Technol., 5(4):304-305, April 1971.

In a secondary lead smelter where lead from old batteries is remelted and used to make new ones, odors from the smelting process are disposed of by incineration at 2400 F; lead oxide emissions and lead aerosols are trapped by baghouses; and sulfur oxide emissions are scrubbed with a venturi scrubber and mist eliminator. All water and acid from the operation in which the tops of old batteries are sheared off are collected, retained, and subsequently neutralized to eliminate acid before discharge to a water course. Old battery cases are crushed and used as landfill.

30260

ENVIRONMENTAL POLLUTION CONTROL INDUSTRY HANDBOOK-SPECIAL ISSUE FOR ENVIRONMENTAL POLLUTION CONTROL EXHIBITION 71. (Kogaiboshi sangyo Yoran. 71 kogaiboshi sangyoten. Kankyo eisei kikiten tokushu). Text in Japanese. Japan Nippon Kogyo Shinbunsha and Kankyo Kogai Shinbun, March 1971. 128p.

A list is compiled of companies manufacturing environmental pollution control devices. Companies manufacturing control devices exclusively for air pollution and odor are included. For each company, key personnel, plant locations and products are given, together with its agents. The remaining pages of the handbook are ddevoted to laws and regulations for environmental pollution control, government agencies, measurement methods, sulfur contents of oils imported by Japan, flue gas desulfurization methods, auto exhaust control, leasing and financing control devices, and books on environmental pollution. The list is exhaustive and the book is useful as a reference in choosing control devices for a specific problem in the field of environmental pollution control.

30339

Jonsson, Sven-Erik

EVAPORATION OF BLACK LIQUOR: DEVELOPMENT TO DATE FROM THE STANDPOINT OF ENVIRONMENTAL PROTECTION. (Industning av svartlut: Nagra utvecklingslinjer hittills fran miljovardssynpunkt). Text in Swedish. Svensk Papperstid. (Stockholm), 7:191-196, April 15, 1971.

Three problem areas in the evaporation of black liquor are: reducing the loss of solids (containing sodium sulfate); recovering sulfur compounds from liquid and gaseous wastes; undesirable biochemical oxygen demand of condensates. The volatile sulfur compounds liberated by the evaporation of black liquor are 80-90% hydrogen sulfide, the remainder consisting of thiols. Unless measures are taken to prevent it, sulfur compounds will be found partly dissolved in the condensate and water from the vacuum pump set, while part will be liberated in the form of uncondensable gases. The oxidation of black liquor has a history of 40 years. In more recent times the Uddeholm method has been used to recover sulfur compounds from the liquid and gas phases. The condensate is purified in a column, which removes almost 100% of the sulfur compounds. Gases with an unpleasant odor are collected and neutralized by means of combustion. Another new method is the Delary system, which is also described.

30350

Kurmeier, H.

THE LIMESTONE-TOWER PROCESS FOR DEODORIZING ODOROUS INDUSTRIAL WASTE GASES. (Das Kalkstein-Turmverfahren zur Desodorierung von riechenden Industrieabgasen). Text in German. Gesundh. Ingr., 92(6):169-173, 1971. 9 refs.

For ten years now, odorous waste gases from industrial processes have been treated by passing them through a tower packed with calcium carbonate. Prior to entrance into the tower, chemicals are sprayed into the gases. This process has been successfully applied in the food industry. Criticism that the injection of chlorine into the odorous waste gas prior to entry into the limestone tower does not eliminate the odor but masks it was unfounded by laboratory tests. Chlorine was converted into neutralized hydrochloric acid and HC10. A medium-size plant with a waste gas througput of 40,000 cu m/hr requires about 200 g Cl/hr.

30479

Katagiri, Toshio and Kenzo Tatematsu

DUST-COLLECTING DEVICE. (Shujin sochi). Text in Japanese. (Matsushita Denki K. K. (Japan) Japan. Pat. Sho 46-5519. 2p., Feb. 10 1971. (Appl. Feb. 2, 1967, 1 claim).

An air cleaner equipped with a filter of activated carbon fibers and designed to perform electrical and mechanical dust removal and deodorization is described. The structural arrangement of the dust-collecting unit is similar to that of an electric dust collector. Several discharge lines are fitted in parallel to the activated carbon filter. The lines are linked with each other by means of a lead wire connected to the positive side of the power source, while the filter is connected to the negative side. When high voltage is applied between the filter and the discharge line assembly, corona discharge takes place between the two electrodes. Dust coming into the electric field formed between the two is, therefore, charged and attracted by the filter. Since the filter is porous, it also performs mechanical filtration. Ozone generated by the corona discharge and harmful gases flowing into the unit are removed by the filter made of activated carbon fibers giving deodorization function. The use of this new tri- purpose filter improves dust collection efficiency and removes the need of another filter for deodorization. Porous in structure, the filter is highly flexible and can be easily rolled up for storage or replacement.

30530

Nakai, Yoshiyuki

ON ELIMINATION OF OBNOXIOUS GASES AND COUNTERMEASURES. (Akushu gasu no jokyo to sono taisaku ni tsuite). Text in Japanese. Kogai To Taisaku (J. Pollution Control), 6(2):61-72, March 1971.

Because of the large amounts of dust they contain, obnoxious gases are not completely eliminated by methods such as adsorption on activated coal or catalytic oxidation by (nickel or platinum). The dust adheres to the surface of the activated coal or the catalyst, thus lowering their efficiency. The steam generated also lowers the efficiency of reaction. The molecular cross section of a harmful gas is extremely small and the atomic distance of activated coal and catalysts seem to have a great influence, as does the distance between grid points of a catalyst surface. Included among dust collecting equipment are venturi scrubbers, cyclone scrubbers, and bag filters. A wet type bag filter is effective. In any method, power costs are very great. The Kanagawa Prefectural Industrial Experiment Laboratory devised a wet-type gas absorbing apparatus that has a 95% collection rate and traps dust from five to 20 micron. Equipment for eliminating gas and sulfur, also devised by the Laboratory, is more than 90% effective. The waste liquid absorbed is made harmless with caustic soda. A dry-type drier, devised by the Laboratory, renders material completely odor free. The material is heated in an incinerator continuously, and the obnoxious gas and steam generated are washed and cooled. Their heat is recorded as secondary air for the burner. When water content is less than 85%, the drier can be used for sludge, bone meal, and dead animal carcasses.

30738

Waid, Donald E.

THE CONTROL OF ODORS BY DIRECT FIRED GAS THERMAL INCINERATION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 50p., 1971. (Presented at the Air Pollution Control Association Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-23.)

The thermal incineration process and its application to odor control are discussed. Thermal incineration is the process of oxidizing combustible material by raising the temperature of the material above its auto ignition temperature and holding it there for a brief period of time to complete its oxidation. Direct flame thermal incineration can control organic air pollutants to almost any desired limit. The simple control of temperature allows the required amount of pollutant control. This flexible method can be changed simply as the code requirements change by modifying the operating temperature. In many cases, the oxygen from the effluent can be used for combustion, reducing the fuel consumption requirements. When the heat is reused in the system or elsewhere in the plant, little fuel is needed for incineration. The planning and designing of a thermal incinerator are discussed. Plant survey information required, design objectives, and operating parameters for the unit are listed. Extensive field tests and field experience are cited to point out the practical aspects of successful and efficient design and operation of thermal incinerators. One advantage of this method is that total hydrocarbon and carbon monoxide control can be combined with odor control in the same process. (Author abstract modified)

30773

Hescheles, C. A.

ULTIMATE DISPOSAL OF INDUSTRIAL WASTES. American Society of Mechanical Engineers, New York, Incinerator Div., Proc. Natl. Incinerator Conf., Cincinnati, Ohio, 1970, p. 73-77, 235-243. (May 17-20.)

A description is presented of a new disposal facility designed to chemically treat and/or to incinerate, without pollution, industrial wastes received from process industries within a regional area. Noncombustible liquid wastes will be chemically treated to render them inoffensive and nonpolluting. The clean effluent will be returned to nature, and the solids will be used for land reclamation. Combustible liquids and combustible solids will be incinerated in a Loddby furnace and rotary incinerator, respectively. Both furnaces are noted for high-temperature, turbulent, and efficient combustion. Discharge gases from each furnace enter a common afterburner, where the combustion of unburned particles is completed before entering a common gas scrubber. A gas-impingement scrubber has been selected to neutralize acids, remove particulates, and to cool the flue gases. The ash resulting from incineration will also be used for land reclamation. (Author abstract modified)

30782

Shibahara, Toshio

ASSEMBLY OF FILTER ELEMENTS FOR AIR CLEANER. (Kuki seijoki no firuta so). Text in Japanese. (Matsushita Seiko K.K. (Japan)) Japan. Pat. Sho 46-12463. 2p., April 30, 1971. (Appl. March 14, 1968, claims not given).

An air cleaner is equipped with a filter unit consisting of several filter layers: pre-filter, deodorizing filter, rear filter, and high-performance filter. These filter layers are installed separately in the cabinet of the air cleaner. Since the internal space of the cabinet is limited, to install them separately is difficult, time-consuming and requires more space for the installation. A method for installing the filters as one block is described. The filter elements are placed in the following order, from bottom to top: prefilter, deodorizing filter, rear filter, and high-performance filter. An L-shaped frame is fitted to the right end of the prefilter and the rear filter. The right end of the deodorizing filter is trimmed by a U-shaped frame. The highrperformance filter is not trimmed by a frame. The upper two filters are shorter than the lower two, leaving an oblong space above the extra portion of the lower two filters. A block-like supporting frame for the upper two filters fills this space. A large U-shaped frame is mounted to hold all four filters and the supporting frame in place. The large U-shaped frame is mounted in such a way that its lower bent edge goes under the bottom of the right-end portion of the prefilter, while its upper bent edge goes to the top side of the supporting frame. The large U-shaped frame can slide sideways. It has a slit whose right side is open so that it may become engaged with a tightening bolt when the frame is slid to the right. The bolt is a butterfly type, and plunges through the supporting frame into the right end of the rear filter. Since the L-shaped frame fitted to the rear filter has a screw hole, the butterfly bolt can be screwed to hold the entire assembly tightly in place.

30809

Courau, P. J.

THE ELIMINATION OF ODORS. (L elimination des odeurs). Text in French. Cah. Med. Inter Profess., no. 41:61-69, 1971. 8 refs.

Unpleasant odors are being released into the air in installations of various kinds, such as slaughter houses, dairies, breweries, distilleries, tanneries, oil refineries, coke oven batteries, and chemical and pharmaceutical plants. Odor is a volatile emanation which causes sensations in the human olfactory system. Methods of analysis of odors are mostly of a subjective nature. Odors are classified in relation to their quality, intensity, acceptability, and power of penetration. Odor quality is characterized by relating it to that of well known odorants, such as coffee, onions, and fruits. The intensity of odor is usually defined by one of four classes: absence of any odor, odor hardly perceptible, marked odor, and excessive odor. Acceptability signifies the agreeable or disagreeable character of an odor. In some cases an odor of a certain quality can be aggreeable at low intensity, but disagreeable at higher concentrations. Power of penetration means the aptitude of an odor to spread in a substantial volume of air and be perceptible in it. Methods for eliminating odors can be summarized as follows: controlled circulation of air between a room with stronger odors and one without; Dilution of odors with outside air by ventilation; circulation of interior air through an installation for trapping odors by adsorption or absorption where active charcoal is widely used as an adsorbent; use of substances for masking or neutralizing odors; aspiration of odors directly at the source, and evacuation of the same to the open atmosphere; thermal or catalytic combustion; and ozonization.

30865

Hurn, R. W.

MOBILE COMBUSTION SOURCES. In: Air Pollution. Arthur C. Stern (ed.), Vol. 3, 2nd ed., New York, Academic Press, 1968, Chapt. 33, p. 55-95. 43 refs.

Mobile combustion sources include automobiles, trucks, buses, railroad locomotives, aircraft, and marine vessels. Pollutants from these sources contain both toxic compounds and organic materials that are not in themselves objectionable but which react in the atmosphere to form smog. In addition, objectionable smoke and odor, separately or together, may accompany other exhaust emissions. It is useful to treat internal combustion engine-powered vehicle emissions according to their origin within the vehicular system. Exhaust emissions may include carbon monoxide, unburned hydrocarbons, oxides of nitrogen, partial oxidation products, and particulate matter. Evaporative emissions and crankcase blowby, and the chemical composition and photochemical reactivity of hydrocarbon emissions are discussed. Air-fuel ratio and other operating variables which influence the relative properties of combustion products are cited. Automotive emissions control is discussed, as well as testing for certification and inspection of vehicles. The nature of diesel emissions is reviewed, including fuel and engine effects on diesel emissions. Gas turbines operate with fuel mixtures that, overall, are extremely lean compared with the mixture ratios used in spark-ignited piston engines. Emissions from automotive and aircraft gas turbines are mentioned.

30943

Edwards, Frank R.

OXIDATION PROCESSES FOR CONTROLLING FUMES AND ODORS. Plant Eng., 25(14):49-50, July 8, 1971.

Catalytic and thermal oxidation processes are discussed in connection with the control of fumes and odors. The catalytic unit includes a preheat burner, a process blower, a catalyst bed, a control system, and safety equipment. Thermal units differ only in respect to the type of burner and the size and contents of the combustion chamber. Catalytic oxidation units are smaller and generally weigh less than comparable thermal incinerators. The costs of thermal incineration are controlled by the choice of burner and its associated efficiency. The efficiency can be improved by designing to increase residence time, turbulence, and operating temperature. The efficiency of catalytic units can also be increased by using a greater quantity of catalyst and by increasing the operating temperature. In either case, the operating temperatures are chosen to achieve the desired results. Catalytic combustion systems are gaining in popularity for a number of emission control applications, including food and chemical processing and metal finishing.

31062

Green, William and Thomas Elliott

CONTROL OF RENDERING PLANT ODORS IN PHILADELPHIA. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 40p., 1971. 6 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-9.)

The history of rendering plant odor control methods in Philadelphia is discussed. The development of the coordinated administrative and technical efforts involving emission limitation standards, equipment specifications, and operational modifications is outlined. The history of odor control technology relates development from the early counteractant methods through hot wells, condensers, and venturi scrubbers and the more recent methods involving afterburners, incinerators, ozone chambers, potassium permanganate scrubbers, and charcoel absorbers. The effectiveness of these methods as experienced in Philadelphia, the degree of acceptance by the industry, and a view of the control methods that may be required in the future are discussed. This history of odor limitation standards covers the period from 1948, when odors detectable five or more miles from the source were common, to the present, when odors detectable immediately outside the plant are unacceptable. (Author abstract modified)

31072

Kosaya, G. S.

OXIDATION OF BLACK LIQUOR WITH OXYGEN. Bumazhn. Prom. (Moscow), 31(6):15, June 1956. 4 refs. Translated from Russian by Brenda Jacobsen, Washington Univ., Seattle, Dept of Civil Engineering, 5p., Sept. 28, 1970.

Black liquor containing 7.54 gm/l sodium sulfide (Na2S) and 7.4 gm/l sodium sulfite (Na2S203) was oxidized with 100% oxygen, and the effects of temperature, contact time, and intensity of mixing investigated. At 70 C, oxidation of Na2S was completed within a few minutes. The bulk of the sulfide was oxidized to thiosulfate, a part to sulfate. The observed oxygen consumption was 370 cu m/metric ton Na2S, or about 20 cu m oxygen/metric ton of pulp. Oxidation of black liquor with pure oxygen is simpler and more convenient than oxidation by aeration, and has the important advantage of causing no foaming. (Author abstract modified)

31091

Honda, Keisuke

PULP EFFLUENT TREATING DEVICE. (Parup haieki shori sochi). Text in Japanese. (Mitsubishi Heavy Industries, Ltd. (Japan)) Japan. Pat. Sho 46-12521. 5p., March 31, 1971. (Appl. Feb. 13, 1968, 1 claim).

Among the defects of conventional boilers for burning pulp effluent are evaporation of volatile substances in the effluent, reduction of the calorific value of effluent solids on contact with high-temperature gas, and conversion of sulfur oxides and carbon dioxide in boiler exhaust gas to sulfuric acid and carbonic acid. The latter compounds react with the sulfides in the effluent to generate odorous hydrogen sulfide, which lowers the calorific value of solids. High H2S concentrations are harmful to man. The improved equipment described eliminates these problems with an effluent condensation device and an incinerator for heating air. This incinerator is located in the air passage. The condensation device permits direct contact between pulp effluent and heated air and evaporates water from the effluent. Air and condensed pulp from the device are jetted to the incinerator for pulp. The equipment thus has two systems. In the first, air is passed through the air incinerator and condensation device to the air outlet. In the second, or bypass system, air goes through an air-adjustment device. The two systems join at the air outlet of the condensation device, where air temperature is measured to insure that both it and that of condensed effluent are at specified levels. For this purpose, both the air volume adjustment device and the air incinerator are controlled. Because correct temperature is maintained, there is no corrosion problem due to high-temperature air.

31160

Aoki, Teruo

DUST ELIMINATOR. (Jojinki). Text in Japanese. (Assignee not given.) Japan. Pat. Sho 46-13649. 2p., May 14, 1971. (Appl. April 27, 1968, 1 claim).

The cleaner in a dust eliminator was improved. A spray pipe is located in the core of a cylindrical cleaner which has suction inlet at one end. The wall facing the spray pipe holes is multisided. Several wire nets are on the inside of the suction inlet and on the side of the discharging outlet to form partitioning walls. Inside the cylinder near the suction inlet, there are spray nozzles in the direction of turning. The dust-laden air is fed into the cylinder with a horizontal axis, and the dust is eliminated by the pressurized spray. When the air goes through the holes of the partitioning wall and enters the upper chamber, it is again sprayed, where both odor and gases are eliminated. Cleaned air is discharged from the top. As the nozzles on the side of the suction inlet turn the sucked-in air for even spraying, the sprayed water hits the multi-sided wall, and very fine particulates bounce off. In spite of compactness, this cleaner is very effective for the elimination of dust, odor, and gas.

31167

Krahl, H.

CATALYTIC WASTE GAS CLEANING. (Katalytische Abwassereinigung). Text in German. Chem. Rundschau (Solothurn), 24(27):625-626, 1971.

Catalytic exhaust gas cleaning is discussed with the aid of three practical examples. It is very economical to clean the exhausts of diesel engines. Diesel fuel is lead-free and no catalyst toxicants are present; no additional equipment is needed. The cleaning effect can be improved by using higher temperatures. Odor annoyance is drastically reduced and the soot content is slightly reduced. Catalytic waste gas cleaners with auxiliary heating are used in tanneries and similar plants. The temperatures of the waste gases in these plants are below the ignition temperature, so that auxiliary heating is required. The efficiency of catalytic afterburners in such cases ranges between 94 to 98%. The carbon monoxide concentration is 99.8% removed. When the waste gas volume is large, energy recovery becomes economical. A plant drying starch is given as an example. The waste gases need auxiliary heating and preliminary cleaning in a scrubber for removal of substances which impair the functioning of the catalyst. Through a blower, the waste gases are pressed into combustion chamber where they are heated to the necessary temperature. The cleaned hot waste gases are used for drying.

31173

Ricketts, C.

THE CONTROL OF OFFENSIVE ODORS: RESULTS OF A SURVEY. Environ. Health, 79(5):136-138, 140-142, May 1971.

A survey was conducted to determine the amount and the quality of odor control in several types of industries in urban areas. Questionnaires were sent to public health inspectors, asking them to indicate the odor producing trades in their districts. A list of control methods was included and each trade was to be indicated with respect to the control method applied to it. The operations covered by the survey were: the food industry, the chemical industry, the metal industry, and unscheduled offensive trades. From a total of 141 operations, 51% were controlled, of which 59.7% were successfully controlled. The overall success rate of controlled operations related to the total number of operations is 30.4%. The most effective methods are electrostatic precipitation, combustion, and absorption. Control methods involving the use of proprietary chemicals were the least effective.

31211

Clapham, T. M., T. J. Junker, and G. S. Tobias

ACTIVATED CARBON-ODORANT REMOVAL FROM AIR QUANTIFIED. ASHRAE (Am. Soc. Heating, Refrig. Aircond. Engrs.) Trans., vol. 76, part 2:75-86, 1970. 6 refs. (Presented at the ASHRAE Annual Meeting, Kansas City, Mo., June 28-July 1, 1970.)

An attempt has been made to establish performance data which will provide a sound and effective basis for the application of activated carbon for odor removal. Another aspect of the study concerned the dynamic aspects of odor removal with thin beds of activated carbon. The approach was to measure the efficiency of odorant removal with time at conditions of flow and concentration typical of an air conditioning system. It was found that the capacity of activated carbon for most organic chemical odorants in air, in the low concentration range, can be determined by direct computation from physical data or by extrapolation from a minimum of experimental data. A technique was developed for measuring odorant breakthrough on thin bed activated carbon filters. This technique has been used to study the key variables in odor removal and to develop a relationship between static equilibrium and flow performance. This relationship, which will allow prediction of breakthrough curves from static equilibrium data, needs to be verified by further study. (Author summary modified)

31223

Kosaki, Motokiyo

ON EQUIPMENT DESIGNED TO DISPOSE OF COMBUSTIBLE WASTE GAS AND DISPERSE IT INTO THE ATMOSPHERE. (Kanensei haigasu taiki hosen setsubi ni tsuite). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 38(7):17-26, July 1971. 5 refs.

Combustion/dispersion equipment, designed to remove the combustibles, noxious contents, and offensive odors from waste gases by combustion, and thereafter discharge the waste gas for atmospheric diffusion is described. The Technical guidelines for designing the respective component units of the equipment or plant are also described. Among the combustible waste gases are blast furnace gas, coke oven gas, converter furnace gas, metal refining waste gas, naphtha refining waste gas, gasoline cracking gas, and hydrocarbon cracking gas. The main component units of the equipment include a knockout drum, seal tank, flame arrester, ignition device, flare gas burner, and stack with a stack support tower. The knockout drum is designed to remove solids, liquid contents, and condensate from the saturated gas contained in the flare gas, and water content given off from washing. The seal tank prevents back fire from going from the flare stack to the flare gas line. The tank is kept filled to a specified water level to seal the mouth of the flare gas line, which is held underwater. The flame arrester also prevents back fire. The ignition device ignites the pilot burner, which in turn ignites the flare gas burner nozzle, located above the ground level. The ignition device allows the burner to be ignited from the ground level. The flare gas burner comes in various sizes and types, and can be selected according to operating conditions. The stack and stack support tower can also be built to suit the operational conditions.

31233

Imai, Takao

GASEOUS POLLUTANT CLEANING AND INDOOR ENVIRONMENTS. (Gasujo osenshitsu no joka to shitsunai kankyo). Text in Japanese. Kuki Seijo, (Clean Air J. Japan Air Cleaning Assoc., Tokyo), 8(2):27-47, March 1971.

Air pollutants include dust, microorganisms, noxious gases, and offensive odors. While an air filter developed for the effective removal of dust and microorganisms has been widely used with an air conditioner or ventilation device, the need to remove gaseous pollutants, including offensive odor, from air during air conditioning has only recently come to attention. The noxious gases and odors in connection with indoor environment are discussed. An elaborate discussion of offensive odor in a room was made to give a required air volume per occupant. The gaseous air pollutants, carbon dioxide, sulfur dioxide, carbon monoxide, nitrogen oxides, and hydrocarbons, emitted from boilers and automobiles, were listed. A study on the odors from occupants of a room was cited. Based on this study, the ventilation requirement for an average Japanese room occupant was estimated at 470 cu ft, if the body odor in the room is to be kept below a moderate level. Studies concerned with the odor of cigarette or cigar smoke were cited to give basic idea about the characteristics of the smoke affecting the indoor environmental condition. According to one study the number of smoke particles was estimated to be three times 10 to the 9th power/cc at the initial stage, and its size at 0.1-0.5 micron. The CO contained in the smoke of various cigarette brands ranged from 3.8 to 53.8 mg. The ventilation requirement per room occupant, established according to the smoke intensity is shown in tabular form. Of the control methods for the odors and noxious gases, the adsorption method for activated carbon is recommended. Various deodorization methods are introduced with their respective advantages and disadvantages. The swelling threshold density of various substances, such as chloroform, methyl alcohol, carbon tetrachloride, and sulfuric acid are tabulated, with activated carbon s retentivity for the respective substances.

31301

Maier, Alfred

PROTECTION AGAINST IMMISSION IN THE WOODWORKING INDUSTRY. (Immissionsschutz beim holzbearbeitenden und -verarbeitenden Gewerbe). Text in German. Wasser Luft Betrieb, 15(6):214-219, June 1971. 8 refs.

Woodworking industries may pollute the neighborhood through dust emissions from firing systems, odors from lacquering stations, and wood and sawdust from wood cutting and polishing. Firing systems are usually heated with wood. Measurement of the dust content in the waste gases revealed that the dust may range from 650 to 4000 mg/cu m which grossly exceeds the 300 mg/cu m demanded by the VDI standard 2300. The dust is very fine-grained. About 50% of the dust was below 10 micron. The fraction of unburned material was almost 50% and the specific weight of the dusts averaged 1.9 g/cu cm. For efficient dust collection, centrifugal separators can be used. The fine dust developing at wood polishing machines is pneumatically drawn off and collected by cloth filters.

31302

Bendl, Herbert

IMMISSION PROBLEMS IN LARGE ANIMAL BREEDING STATIONS. (Immissionsprobleme in grossen Tierbestaenden). Text in German. Landtechnik, 26(14):375-377, July 1971.

The tendency toward concentration of animals in breeding stations compounds the problem of odor emission. The annoying odors in stables come from manure components, such as ammonia, hydrogen sulfide, mercaptans and amines. The annoyance of these substances is determined by human odorimetry, since no other measurement method is yet available. The odors should be avoided by immediate separation of feces and urine. Mechanical manure removal systems should be installed. Any motion of the air immediately above the manure should be avoided so that the heavy gases are not stirred. The use of deodorants actually means further pollution since the odors are only masked by another strongly smelling substance. It is better to use scrubbers, filters, and combustion for the removal of odors.

31354

Eguchi, Yoshitomo

PRESENT STATE AND ECONOMICAL SIDE OF AIR CLEANER FOR HARMFUL GASES. (Yugai gasu yo kuki sejo sochi no genjo to keizaisei). Text in Japanese. Kuki Seijo (Clean Air-J. Japan Air Cleaning Assoc., Tokyo), 8(2):48-62, March 1971. 20 refs.

A discussion on the functions of air conditioning equipment and the removal of dust and microorganisms is presented. The removal of harmful gases and odors, such as sulfur dioxide, carbon monoxide, and nitrogen oxides is the most important function. Charts and graphs showing the annual change in SO2 concentrations in major cities, the effects of SO2 on human health, the estimated emission of SO2, and other similar data are presented. The concentration of air pollutants has sharply increased with an increasing consumption of petroleum fuel in recent years. The need to remove them by an air filter in an air conditioner is increasingly important. According to a 1967 survey, CO emitted from petroleum fuel combustion was estimated at 5080 kt (kilotons) for all of Japan and at 857 kt for Tokyo; SO2 at 3110 kt and 444 kt; nitrogen oxides at 1160 kt and 181 kt; hydrocarbons at 1100 kt and 172 kt; and micro-particulates at 211 kt and 30 kt. Pollution of the indoor air is often indicated by an offensive odor. Types of odor and substances causing odors are listed. Odor-causing substances with their allowable limits, smelling threshold densities, and adsorption retentivities are also tabulated. The commercially available air purifiers designed to remove these harmful gases and odors come in four types; activated carbon air filter, activated carbon sheet air filter, air filter using an alkali-coated filter element, and a catalyst air filter. The advantages and disadvantages of the respective types are briefly discussed.

31400

Acres, G. J. K.

PLATINUM CATALYSTS FOR DIESEL ENGINE EXHAUST PURIFICATION. Platinum Metals Rev., 14(3):78-85, July 1970. 4 refs.

Despite the low concentration of exhaust emissions from diesel engines, when these are emitted into a confined atmosphere they can create a health problem. Many diesel engines are operated in confined spaces in units such as mine locomotives, lifting equipment, and stationary electric power generators. Particularly hazardous in these conditions is carbon monoxide. Another problem is the unpleasant odor associated with diesel exhaust gases and the effect of these gases on the eyes and throat. The origin of the various emissions in diesel exhaust gases is considered. The various emissions include smoke, carbon monoxide, hydrocarbons and partially oxygenated hydrocarbons, and oxides of nitrogen. By careful attention to detailed engine design and by limiting the power output, the exhaust gas emissions may be minimized but not eliminated. The two most common exhaust gas purification systems in use are water scrubbing and catalytic combustion. A catalyst system is described which combines the high activity/low ignition temperature properties of platinum with the unique properties of a honeycomb ceramic support. Tests which were undertaken to determine the effectiveness of this system are presented.

31453

Heaney, Frank L.

AIR POLLUTION CONTROLS AT BRAINTREE INCINERATOR. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 10p., 1971. (Presented at the Air Pollution Control Association Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-71.)

When the Town of Braintree, a suburb of Boston, discovered that its huge rubbish dump was to be displaced, efforts were made to locate a suitable site for an incinerator. Components of the incinerator plant were to include platform scales, scale house, refuse storage, traveling bridge crain, continuous feed furnaces, flue gas cooling by steam generation, electrostatic precipitators, induced draft fans, and an insulated double wall steel stack. The lowest bid received was based upon water wall furnaces, with integral boilers and economizers. Operating variables and pollution problems associated with water walled incineration are discussed. Pollutants include fly ash, smoke, and odors which can be eliminated by high combustion temperature and electrostatic precipitators.

31456

Miura Kagaku Sochi K. K. (Japan)

ON DESULFURIZATION OF EXHAUST SMOKE BY TURNING-FLOW GAS LIQUID CONTACT METHOD. (Senkairyu kieki sesshokoho ho yoru haien datsuryu ni tsuite). Text in Japanese. Nenryo oyobi nensvo (Fuel and Combustion), 38(5):51-58, May 1971.

A conventional wet type desulfurization/dust removal method designed to clean exhaust gas usually requires 20 l wash water/cu m of gas to be treated. Suppose the water consumption is 10 l/N cu m the total amount of waste water will be 500 T/hr when an exhaust gas of 50,000/N cu m/hr is treated. It thus requires a great amount of extra cost to treat the waste water. Designed to minimize the water consumption, and yet assure high efficiency of dust removal and desulfurization, are the Blue Bird, a scrubber for dust removal, and the Totempole, another scrubber for the removal of sulfur dioxide absorption of gas, and removal of odors and fumes from boiler exhaust gases. Two cages with a number of tangential slits are provided within a bottle-like cylindrical unit. The lower one is the intake cage, and the upper is the discharge cage. The gas intake port is provided in the lower side of the cylindrical unit. This assembly of the cylindrical casing, the intake cage, and the discharge cage makes the basic unit. The Blue Bird consists of one basic unit, while the Totempole has two or more basic units. With the Blue Bird, the dust-containing exhaust gas flows into the intake cage through the slits at a velocity of 15-25 m/sec and moves upward turning at the high speed. It is then discharged at the same velocity through the tangential slits of the discharge cage. The slits are 3 mm, 5 mm, or 10 mm wide, so that the high-speed gas atomizes water membranes, formed on the inner walls of the slits, as it flows through. Since there is a high-speed turning current in the cage, the atomized water droplets are driven toward the inner walls of the slits by the centrifugal force, and form water membranes. The dust is also driven toward the inner walls of the slit by the centrifugal force, and are thus arrested by the water membranes. The water, having now adsorbed the dust, is discharged through the slits of the discharge cage together with the gas that it turning at the high speed. The dust is then separated from the water in a centrifuge provided above the scrubber unit. Similar principles applying to the Totempole, except that the scrubbing is repeated at several stages, since the gaseous substances or fume-like micron dusts are too small to be removed by a one-stage process.

31463

Blue, Jerry D. and William F. Llewellyn

OPERATING EXPERIENCE OF A RECOVERY SYSTEM FOR ODOR CONTROL. Tappi, 54(7):1143-1147, July 1971. 2 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Engineering Conference, Denver, Colo., Oct. 25-29, 1970.)

The first operating experience of a control odor recovery system at the Halsey, Oregon, kraft pulp and paper mill of the American Can Company has consistently shown daily average total reduced sulfur emission levels of approximately 1.0 ppm, with sulfur dioxide emissions below 200 ppm. The recovery boiler design eliminates direct-contact evaporation and fires unoxidized black liquor supplied directly from multiple-effect evaporators. The operation has met or exceeded predicted emission limits. A collection and thermal oxidation system for miscellaneous emission sources has also contributed to mill operation essentially without odor. (Author abstract)

31472

Maier, Alfred

IMMISSION PROTECTION IN THE WOOD WORKING INDUSTRY. (Immissionsschutz beim holzbearbeitenden and und -verarbeitenden Gewerbe). Text in German. Wasser Luft Betrieb, 15(7):261-264, July 1971.

In lacquering stations of wood working plants, odorous solvent vapors develop which are mixed with the lacquer dust. Wet collectors are best suited for the removal of such emissions. With them, collection efficiencies of 99 to 99.5% can be achieved. Such high efficiency, however, is achieved only for the particulates in the vaporous emissions. For the solvents, the efficiency is low. Examinations of a cascade scrubber for emissions consisting of 29 mg/cu m of particulate matter and of 353 mg C/N cu m revealed that by doubling the water quantity the particulate emissions could be reduced to nine mg/cu m. However, the solvent emission was reduced to only 325 mg C/N cu m. The highest efficiency is achieved with a scrubber operating on the venturi principle. The lacquer mists are drawn off by a venturi-type nozzle. The atomized water droplets adsorb the lacquer particles. The water droplets are separated on subsequent steel sheet plates. An efficiency of 99.8% can be achieved.

31631

Muir, Arthur J.

THE APPLICATION OF SONIC TECHNOLOGY IN THE PREVENTION AND CONTROL OF AIR POLLUTION. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 46p., 1971. 9 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-82.)

Completeness of combustion is directly related to the quality of fuel atomization prior to ignition. The mechanism of sonic atomization is described and related to improvements in the basic combustion process. Data on industrial oil burner installations are reported including a case history in which improvement of combustion efficiency resulted in a reduction of particulate emissions by 84-87% relative to the national average. The use of sonic atomization in industrial oil burners not only reduces soot emissions but also cuts fuel, maintenance, and labor costs. Similar performance improvements and emissions reductions are cited by the use of sonic fuel atomization in home oil burners, automotive carburetion and fuel injection systems, catalyst regenerators, afterburners, steam engines, diesel engines, and liquid waste incinerators. A case history describes the use of an auxiliary sonic atomizing burner to regenerate catalytic mufflers used in diesel engines. Non-combustion applications of sonic atomization are described including evaporative gas cooling, smoke and dust suppression, and odor control. A case history describes the use of sonic atomizers to spray water into hot gases from a copper smelter. (Author abstract modified)

31700

Singer, Robert E.

HOW TO CURB ODOR POLLUTION. Am. Dyestuff Reptr., 60(8):30-33, Aug. 1971.

Of the odors generated by textile processing, the most important is free formaldehyde, normally associated with resin finishing. The addition of a chemical counteractant, usually as the first ingredient in the finish bath, noticeably lessens the effects of formaldehyde fumes, e.g., eye and nose irritation, throughout the production plant and storage areas. In addition, the counteractant reduces the pungent odor of the gaseous plant effluent to the atmosphere. A counteractant developed for formaldehyde control also controls amine odors coming from the nitrogen-bearing portion of resins. Other counteractants are used for odors from polyester dyeing, sulfur-dyeing, hydrosulfite reduction and stripping, and for the smoke produced by heat- setting of polyester. Odors due to chlorine dioxide bleaching are better controlled by buffers. Costs of liquid counteractants are low: approximately 0.0001 cents/running yd of fabric.

31790

Buxton, Winslow H., Jr.

PROCESS AND APPARATUS FOR PULP MILL CHEMICAL RECOVERY AND ODOR ABATEMENT. (Western Kraft Corp., Albany, Oreg.) U. S. Pat. 3,574,556. 6p., April 13, 1971. 13 refs. (Appl. March 4, 1969, 8 claims).

A process and apparatus are presented for the recovery of chemicals and the abatement of odors emitted by the recovery furnace of kraft pulp mills. Gases from the discharge stack of the recovery furnace are diverted to an afterscrubber in which they are sprayed with an alkaline weak wash liquor resulting from the washing of calcium carbonate mud and solid dregs produced by causticizing the green liquor. Thus, hydrogen sulfide, mercaptans, and other malodorous gaseous compounds are removed. Corrosion is minimized, heat is recovered, and a problem of waste disposal in the mill effluent streams is avoided. (Author abstract modified)

31794

OXYGEN TREATING IS PROVING FEASIBLE. Can. Chem. Process., 55(4):52-54, 56, April 1971.

Among newer techniques being groomed for use in the pulpmill are soda-oxygen pulping, oxygen bleaching of pulp, and other oxidation systems using oxygen instead of air. One result of such wide use of oxygen would be the need for a tonnage oxygen (air separation) plant at or near most pulp and paper complexes. With tonnage oxygen available, it becomes feasible for existing kraft mills to conduct oxidation of black liquor with oxygen and hence automatically reduce the amount of malodorous off-gases produced in the chemical-recovery system. Similarly, existing biological treatment plants for wastewater could be upgraded in operation through the use of oxygen instead of air as the aeration medium. The use of an oxygen stage and the consequent reduction in chlorine charge to the bleachery introduces the possibility of lowering bleachery pollution by over 50%. Operating variables at several plants are mentioned.

31911

Obata, Kinichi

COMBUSTION DEODORIZER. (Nensho dasshu sochi). Text in Japanese. (Nikko Sangyo K. K. (Japan)) Japan. Pat. Sho 46-16475. 2p., June 6, 1971. (Appl. Jan. 31, 1968, claims not given).

A combustion deodorizer effectively preheats odorous gas with heat produced by combustion. Thus, the 700-800 C combustion temperature necessary for gas deodorization is easily and economically attained. A blower is installed in the top corner of the device; its intake port is connected to the gas intake pipe and the discharge port is connected to the gas channel box housing several heat-exchange pipes. The interior of the device is horizontally divided into three sections. Vertical divisions partition the interior into two vertical compartments. The lowest horizontal compartment serves as the combustion chamber. The odorous gas in blown into the gas channel box. Then it flows through the heat-exchange pipes into the upper part of the right vertical compartment. Next, it passes through the middle and left vertical compartments into the lower part of the right vertical compartment, which is equipped with a burner. The preheated gas, with the high temperature fuel gas blows into the combustion chamber. Then the burned gas flows upward through spaces between the heat-exchange pipes, heating all the pipes. This effectively preheats the odorous gas before it is deodorized by burning. Finally, the deodorized gas leaves through a stack.

31945

Miura, Mitsugu

DUST COLLECTION AND DESULFURIZATION OF STACK GAS BY HIGH SPEED SWIRLING FLOW. (Kosoku senkairyu ni yoru bojin haien datsuryu). Text in Japanese. Netsu Kanri (Heat Management: Energy and Pollution Control), 23(7):40-45, July 1971.

In selecting dust collectors and desulfurization equipment, the dust elimination ratio and desulfurization requirements must be taken into consideration together with equipment costs, operating costs, and the volume of liquid to be used. Wet type dust collectors are cheaper than electric dust collection equipment, bag filters, or dry desulfurization, but the volume of solution required does present a problem. If dust collection and desulfurization efficiencies are to be raised, a lot of water must be used, which generates a considerable amount of effluent. There is a Blue Bird scrubber for dust elimination, and a Totem Pole scrubber for the elimination of sulfur dioxide, gas absorption, odor counteraction, and fume control. These scrubbers utilize a high speed swirling flow, which brings about the maximum effect with a minimum amount of water. As the gas is swirled upward, the film formed on the wall turns to mist, and the dust and droplets are contacted with each other, and blown into the swirling gas stream. Because of inertia, the dust is trapped by the droplets.

32057

Nordrhein-Westfalen Arbeits-und Sozialminister (West Germany)

TECHNICAL POLLUTION CONTROL MEASURES. (Technische Massnahmen zur Luftreinhaltung). Text in German. In: Reinhaltung der Luft in Nordrhein Westfalen. Essen, West Germany, Brinck and Co. KG, 1969, p. 19-45.

Mandatory pollution control improvement programs which were introduced in the state of Nordrhein-Westfalen in 1961 are described. These abatement programs were designed to reduce the emission of pollutants by the steel industry (from, for example, Thomas converters, Siemens-Martin furnaces, flaming installations and ore sintering plants), by iron foundries (including cupola ovens and induction ovens), steam power plants, cement plants, stoneware plants, and by coal processing plants including cokeries and briquette works. In recent years the state government contributed $2.8 million towards the development of improved smoke desulfurization processes and about $280,000. towards the improvement of existing dust arresters. All together five processes which were promising enough to warrant pilot plant tests were further developed: the Reinluft process (adsorption of SO2 on semicoke and its subsequent conversion to sulfuric acid); the additive process (blowing of lime or dolomite dust into the furnace to remove oxides of sulfur); the Still process (absorption of SO2 by the CaO contained in bituminous coal ash); the sulfacid process (wet catalytic conversion of SO2 to H2SO4); and the Grillo process (absorption of SO2 by a contact mass containing metal oxides which is subsequently regenerated). The last process is the most promising of the five for application on a large scale because regeneration is carried out independently and the user does not have to invest in a regeneration installation. New developments in filtering technology are the separation of dusts of high electrical resistance by means of an alternate current filter (ferrosilicon dusts), a new waste gas purification installation for the reduction of the emission of soot and of SiO2 aerosol by silicon carbide plants. The control of odors emitted by the chemical, food and other industries, maximal smoke emission norms, and norms for emissions from incinerator, oil fired furnaces, chemical cleaning plants, plants manufacturing bituminous road building materials, and lacquer drying ovens are discussed.

32070

Turk, Amos

SOURCE CONTROL BY GAS-SOLID ADSORPTION AND RELATED PROCESSES. In: Air Pollution. Arthur C. Stern (ed.), Vol. 3, 2nd ed., New York, Academic Press, 1968, Chapt. 47, p. 497-519. 19 refs.

Adsorption is useful in air pollution control because it is a means of concentrating gaseous pollutants, thus facilitating their disposal, their recovery, or their conversion to innocuous or valuable products. The quantity of material that can be adsorbed by a given weight of adsorbent depends on the following factors: the concentration of the material in the space around the adsorbent; the total surface area of the adsorbent; the temperature; the presence of other molecules in the environment which may compete for a place on the adsorbent; the characteristics of the molecules to be adsorbed, especially their weight, electrical polarity, chemical activity, size, and shape; the microstructure of the adsorbing surface, especially the sizes and shapes of its pores; and the chemical nature of the adsorbent surface, including electrical polarity and chemical activity. Activated carbon, siliceous adsorbents, and metallic oxide adsorbents are mentioned, as well as the effectiveness of adsorbent impregnations. Design principles of adsorption equipment and systems are reviewed. Adsorbent disposed on a carrier is mentioned, as well as thin-bed granular adsorbers, and fluidized adsorbers. Nonregenerative and regenerative systems are cited. The effects of process variables are indicated. Specific process applications include the deodorization of odorous emissions, control of gaseous radioactive emissions, and the removal of sulfur dioxide from flue gas by the alkalized alumina process, catalytic oxidation, the Reinluft Process, and the dolomite process.

32099

Japan Environmental Sanitary Center, Tokyo

REPORT OF THE STUDIES OF THE PREVENTION OF OFFENSIVE ODORS (NO. 3). (Akushuboshi ni kansuru kenkyu hokokusho. (Dai III ho)). Text in Japanese. JESC-42-076. 82p., March 1968.

Environmental pollution problems in every Japanese prefecture include offensive odors from fish meal plants, fish manure mills, and factories for drying chicken droppings. The condition of deodorizing equipment installed in such factories, methods for measuring offensive odors, and future countermeasures were surveyed. Eight models of deodorizing equipment were tested. Construction and maintenance costs of these models are tabulated along with data for currently installed equipment. Since deodorizing equipment associated with a single method does not effectively eliminate odors, deodorization by a combination of methods was postulated. Gas chromatography was adopted as the main method for measuring an offensive odor and as the method for collecting samples. Sampling amines, mercaptans, and organic acids by glass-bead tubes is also described, and results are reported for actual measurements. Based on investigations of the sources of offensive odors at 25 mills, the chief constituents of basic offensive odors are ammonium and trimethylamine. Other low-grade amines were scarcely observed. The usual rate of ammonium and trimethylamine in emission sources is between 1 to 10 and 10 to 1 in fish meal plants and one to one in the factories for drying chicken droppings. In some cases, exhaust concentrations exceeded 100 ppm. Six types of deodorizing equipment were observed, but almost no factory had a satisfactory blueprint for eliminating pollution. The economics of proposed measures are discussed.

32119

Ichikawa, Michio

PLASTIC WASTES DISPOSAL. (Plastic haikibutsu shori). Text in Japanese. Preprint, Smaller Enterprises Promotion Corp. (Japan), 10p., 1971. 7 refs. (Presented at the Public Nuisance Prevention Technique Seminar, Japan, 1971.)

Characteristics of the incineration of various plastics, the substances generated, and their volume and compositon after burning are tabulated and described. Incinerator temperatures must be kept high to assure that the plastics are completely burned. The volume of wastes to be burned and the air needed for burning must also be regulated. If the wastes are in excess, the air will be reduced and too much smoke will be produced; however, if there are not enough wastes, the air will be in short supply, and the incinerator temperatures will be lowered. If harmful gases such as hydrogen chloride are generated, the exhaust gases must be cleaned or neutralized. Other emissions include carbon monoxide, carbon dioxide, nitrogen, oxygen, and polyvinyl chloride. It is often necessary to crush or pulverize the plastics before incineration. Fireproof materials should be used for incinerator construction. In order to lower the costs of incineration, the heat from the process should be utilized. Rotary type and whirling air current type incinerators are described. Fluidized bed combustion is suitable for eliminating odors and for wastes with little water and low-temperatures.

32166

Anderson, Catherine E. and Horst R. Adolf

ODOR CONTROL IN THE RENDERING AND FOOD PROCESSING INDUSTRIES. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 15p., 1971. 6 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-22.)

The effectiveness of potassium permanganate used in the solution of an air scrubber to control the odors related to the rendering and food processing industries was investigated. These odors are caused by the presence of aldehydes, ketones, organic acids, alcohols, organic nitrogen compounds, and organic sulfur compounds. Laboratory scale experiments were performed using a gas washing bottle on these compounds. The effectiveness of odor removal was measured by the syringe technique and by gas chromatographic methods. Odor reduction ranging from 80 to 98% was achieved. Experiments on simulated samples using a 500 cfm Virotrol air scrubber verified the laboratory results. An increase in efficiency of odor removal can be accomplished by increasing the pH of the scrubbing solution. In scrubbers which have a recirculating solution, maintenance of pH at levels higher than nine requires constant adjustment. However, the use of scrubbers in which the solution only passes through once provides a simple way to scrub at any desired pH level. (Author abstract modified)

32302

Clayton, P.

BRICKWORKS ODOURS. A LABORATORY INVESTIGATION OF THEIR PRODUCTION, EVALUATION AND REMOVAL. Ministry of Technology, Stevenage (England), Warren Spring Lab., Rept. LR122(AP), 10p., 1970. 8 refs.

An odor similar to that experienced near brickworks was produced by heating clay at a temperature between 440 and 500 C and diluting the products evolved. The combustion of organic material evolved was monitored with a flame ionization detector; the odor was reduced when the organic matter was removed. The extent of the reduction in odor and decrease in organic content depended upon the residence time of the gases at the temperature of the hot zone and the flow rate of secondary air through the hot zone of the second furnace. (Author abstract modified)

32497

Nuranaka, Kuniyoshi

ON WASTE DISPOSAL FROM PETROCHEMICAL PLANT. (Sekiyu kagaku kojo no haikibutsu hori ni tsuite). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 38(8):1-6, Aug. 1971.

Wastes at the Chiba Plant of the Mitsui Petrochemical Company are plastics produced as by-products from polyethylene and polypropylene processes, but technical developments have provided for their use as fuels. A boiler now exists to burn the polymers. The volume of air is kept at 2-2.5 times the theoretical air volume, and the reactor temperature is maintained at 1100-1200 C. Gas flow and incineration velocity are kept high to avoid local excess heating. By constructing thermal cracking equipment, part of the low polymer by-product is used as fuel for the burner. An incinerator for plastics was constructed in September 1969 at the Chiba Plant and is capable of burning various wastes without odor and damage to the equipment.

32498

Miyagawa, Toshiki

ON DORU METHOD FLUID INCINERATION EQUIPMENT. (Doru shiki ryudo shokyaku setsubi ni tsuite). Text in Japanese. Nenryo Oyobi Nensho (Fuel and Combustion), 38(8):23-32, Aug. 1971.

The Doru incinerator comprises a fluid layer of high temperature sand to which the dehydrated cake of sewage is supplied. As the dehydrated cake is briskly stirred in the fluid layer, it is burned completely in a short period of time. The incinerator is compact in size, costs less to construct, and is also inexpensive to repair since it has no metal parts. Odors in the gas are controlled as the incineration temperatures are high (700-800 deg). There is little excess air, and heat is recovered from the combustion gas. If the incineration is stopped for some time, operation can easily be resumed, since the sand stores heat. An example is given of sewage sludge with a 70-75% water content to be incinerated with equipment capable of handling 10 tons of dehydrated cake a day. The equipment comprises a cake feeder, reactor, heat exchanger, cyclone, scrubber, blower, and compressor. Silica sand is utilized.

32559

Waid, Donald E.

THE ROLE OF DIRECT GAS-FIRED THERMAL INCINERATION IN THE CONTROL OF HYDROCARBONS AND CARBON MONOXIDE BY OXIDATION. Preprint, American Chemical Society, Washington, D. C., 12p., 1970. 7 refs. Presented at the American Chemical Society Middle Atlantic Regional Meeting, 5th, Newark, Del., April 3, 1970.)

Very extensive laboratory tests are described, illustrating the effects of temperature, mixing, and time upon the oxidation of hydrocarbons and carbon monoxide, as well as the elimination of organic odors, by thermal oxidation. The advantages of thermal incineration are explained and the many methods of heat recovery are illustrated. Field test results are included which show the ability to apply this knowledge to production equipment assembled from data taken from 36 different test sites in more than 10 different industries all over the United States. A comparison of these results with Los Angeles County Rule 66 and San Francisco Bay Area Control District Regulation 3 is made. (Author abstract modified)

32615

Kleppe, Peder J.

THE CONTRIBUTION OF INPLANT CONTROLS AND PROCESS MODIFICATIONS TO POLLUTION ABATEMENT IN THE PULPING INDUSTRY. North Carolina Univ., Chapel Hill, Dept. of Environmental Sciences and Engineering, Proc. S. Water Resour. Pollut. Contr. Conf., 18th, Raleigh, N. C., 1969, p. 85-100. 45 refs. (April 9-10.)

Air and water pollution, as caused by the pulping industry, and some control methods are discussed. Water pollution may originate in the woodyard, pulp mill, bleaching plant, or paper or board mill; several methods of reducing this pollution are given. The condensate and non-condensed materials from the evaporators are the major sources of air pollution. In the Kraft process, the non-condensable gases, methyl mercaptan, dimethyl sulfide, dimethyl disulfide, and hydrogen sulfide, are responsible for the characteristic odor. The main pollutant from the combustion furnace is sulfur dioxide. Air pollutants from the liquor preparation are H2S, organic sulfur compounds, SO2, and particulates from the lime kiln. Oxidation of spent kraft liquor before evaporation converts the sulfide to thiosulfate; the sulfur losses by evaporation can be almost eliminated if oxidation is complete. Mercaptans are also oxidized to the less odorous dimethyl disulfide. A reduction in the sulfidity of the cooking liquor and an increase in the alkali charge can reduce pollution caused by sulfur. The vent gases from condensation of blow and evaporator-vapors can be freed of H2S and mercaptans by scrubbing with alkali pulping liquor. The vent gases from the melt dissolving tank and lime kiln are also purified by scrubbing. As much as 85% SO2 removal can be achieved by absorption by a sodium sulfite solution in a venturi scrubber. Particulate emissions from recovery furnaces are reduced with electrostatic precipitators. The present status and future trends in pollution abatement are also discussed.

32634

TOOLS THAT ALLEVIATE POLLUTION. Ind. Power, 62(1):78-88, Jan. 1952.

Removal of contaminants before they reach the atmosphere, both inplant and outplant, reduces air pollution and promotes good relations between companies and residents. Equipment for collecting these contaminants have definite characteristics and efficiencies, and the selection of such a unit depends entirely upon the type and size of particulate. Other factors about the contaminant which must be known include its apparent density, chemical stability, hygroscopicity, volume, the plant site and its operational cycle. The temperature and dew point of the carrying air or gases are also important. Types of collectors in general use are the settling chamber, baffle type collectors, and centrifugal collectors. Removal principles, particle size and efficiency, and air leakage are discussed. Wet methods of removing contaminants from air and gas streams are also described (scrubbers) as well as electrostatic precipitators and filters. Two methods of removing offensive odors and accompanying gases are adsorption and absorption. Incineration and catalytic combustion is also mentioned.

32646

High, M. Dean and Terrence Li Puma

CONTROL OF ODORS FROM A RENDERING PLANT. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 26p., 1971. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-20.)

A study was conducted to evaluate the importance of various rendering plant odor sources and to recommend control techniques for reducing emissions to the atmosphere. Air dilution procedures were used to determine odor concentrations from odor sources and from a pilot control scrubber. Ten chemical solutions were prepared, tested, and referenced to the scrubber efficiency performance of plain water: calcium hypochlorite, chlorine gas, hydrogen peroxide, lime, politol s, potassium permanganate, soda ash, and sodium bisulfite. Odor efficiency tests were performed on two types of odors: those generated by grease cookers, and those from fat and bone conveyors and cookers. Samples were taken from the inlet and outlet sections of the scrubber. Calcium hypochlorite solutions were the most effective odor reducing agents. The recommended control methods include better control over input materials, process changes, changes in operating procedures, and as a last resort, additional air pollution control equipment. (Author abstract modified)

32681

Adams, Donald F.

PULP AND PAPER INDUSTRY. In: Air Pollution. Arthur C. Stern (ed.), Vol. 3, 2nd ed., New York, Academic Press, 1968, Chapt. 39, p. 243-268. 45 refs.

Odorous and particulate emissions are potential by-products from many of the steps in kraft and sulfite pulping processes. In the kraft process, such odorous compounds as methyl mercaptan, methyl sulfide, and hydrogen sulfide are emitted by the digestors and evaporators; lime kilns emit H2S and dusts. In the chemical recovery process, methyl mercaptan, sulfur dioxide and H2S may be discharged. Several methods are available for controlling the gaseous emissions, including black liquor oxidation, combustion of organic sulfur compounds to convert them to SO2, chlorine oxidation, oxidation by air or ozone, scrubbing, absorption by charcoal, and waste heat recovery. Modern equipment for controlling particulate emissions includes electrostatic precipitators, venturi scrubbers, wet cyclones, and de-mister pads. The sulfite pulping process is briefly discussed. Analytical methods used in stack and field sampling are also reviewed. Mercaptans and H2S are determined iodometrically. Sulfur dioxide is measured colorimetrically using the modified West and Gaeke method. Flame ionization detectors have been successfully used in the analysis of organic compounds in kraft mill gases. Instrumental methods for analyzing effluents and suggestions for future research are also given.

32682

Faith, W. L.

FOOD AND FEED INDUSTRIES. In: Air Pollution. Arthur C. Stern (ed.), Vol. 3, 2nd ed., New York, Academic Press, 1968, Chapt. 40, p. 269-288. 16 refs.

Dust and odor are the major air pollution problems in the food and feed industries. In many air pollution jurisdictions, agricultural operations are exempt from air pollution control regulations. However, several agricultural practices contribute to pollution, including soil preparation, crop spraying, weed burning, orchard smudging, fruit and vegetable harvesting, and animal production. In the food and feed industries, wherever a dry powder is produced or handled there is a potential for air pollution from dusts. Principal operations in this category are grain milling, drying operations, mixing of dry feeds and foods, coffee roasting, and related shipping, packaging, and conveying operations. Baffles, cyclones, bag houses, and absorption are recommended to help control this dust problem. The most important segments of the food industry from an odor standpoint are the meat and meat products industry, fish processing, and disposal of fruit and vegetable wastes. Catalytic and direct flame afterburners, a variety of scrubbers, and several odor masking agents have been used for odor control.

32768

Okayama Prefecture (Japan), Industrial Experiment Station

DEODORIZATION AND REMOVAL OF BAD-SMELLING GAS. (Akushu gasu no dasshu jokyo ni tsuite). Text in Japanese. Okayama-ken Kogyo Shikensho Nyusu (Okayama Prefect. Expt. Sta. News), no. 110, 2p., April 1971.

The most effective deodorization is direct burning whereby bad odor gases are sent to a combustion chamber or furnace and burned at a temperature higher than 800 C. However, more than 90% of the material must be oxidized and turned into carbon dioxide, nitrogen dioxide, nitrogen, or sulfur dioxide. When the combustibility of the material is low, use of oxidation catalysts such as platinum-palladium or platinum-rhodium will enable hydrocarbons to oxidize completely and decompose at 260-320 C. These catalysts are unsuitable for treatment of gases which will create catalytic toxins such as sulfur, zinc, mercury, lead, arsenic, fluoride, and tin. Free of contact with such elements, these catalysts will last for 30,000 to 40,000 hours and still be reclaimable. Another deodorizing method which is frequently used in Japan is washing with water, saline water, acids, or alkalies. Water is effective for solubles such as ammonia and amines; acids should be washed with alkalies, and alkaline gases should be washed with acids or should be oxidized by chlorine, chlorine dioxide, or potassium permanganate. Activated carbon is used for the absorption method. Gas washing and adsorption combination can be effectively employed for deodorization of ammonias and amines. The ozone-oxidation method is mainly used for sewage treatment. The amount of ozone required for sewage treatment is reported to be 1 ppm; for restaurants, 5 ppm; fish canneries, 10 ppm; and paper pulp mills, 10-50 ppm. For masking odors, acetic acid benzene, heliotropine, and vanillin are used. More than forty kinds of air wicks, mostly manufactured from plant extracts and chlorophyll, are used for neutralizing different odors.

32781

ENCLOSED DRY RENDERING PLANT ELIMINATES POLLUTION. (Gekapselte Ausschmelzanlage eliminiert die Verschmutzung). Text in German. Wasser Luft Betrieb, 15(8):317, Aug. 1971.

The rendering of slaughterhouse by-products produces fumes and odors which are drawn off from the enclosed cooking container and passed through a filter. Residual fluids are removed from the waste gas in a cooling chamber, which consists of an enclosed cylindrical jacket with cooling pipes arranged inside. These pipes are continuously supplied with water. The waste gases then are sent to a tower where they are scrubbed with a chlorine solution.

32797

Ishiguro, Tatsukichi

ODOR CONTROL OF FISHMEAL AND ANIMAL OFFAL FACTORY IN NORTH EUROPE AND TOKYO. (Kaseiba no akushu boshi taisaku - Hokuo to Tokyoto no baai). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 7(9):811-823, Sept. 1971.

The main odor emission sources in fishmeal manufacturing and animal offal treatment plants are heat processing, especially the desiccation processes; squeezing process; odor from the decomposing material itself; treatment of miscellaneous mixtures in the material; and carrier vehicles and the cleaning water waste. Odor is created also from oil and solubles which the present method of processing does not extract completely from the material. Buildings and the factory sites are saturated by the odor. Main odor producing elements, various measuring methods, and the presently known deodorizing methods are reviewed. Efforts should be made to minimize the creation of odor rather than to deodorize already produced odor; plants should be designed to suit the material types, contents and the degree of freshness; material should be dried indirectly by steam or heated air and the interior of the dryer should be coated with teflon at least half the length of the oven from the entrance; the building material and structure should be erosion resistant and easy to clean; the operations should be checked at a push-button control panel; from the initial chute to the completion of the operation, there should be no leakage of hot air, steam, or liquid; transportation and storage should be designed so that the freshness of material will be maintained; those parts of the facilities where the materials come in contact should be of impervious material; upkeep of buildings should be maintained and greenery and gardens should be added on the site. The best method of deodorization is the combination of water-washing, combustion, and maintenance of freshness of the raw material. A general survey of fishmeal plants in Norway, Denmark and West Germany, and detailed explanations of the De Raval (?) deodorizer, Atlas and ATV deodorization processes are given.

32798

Ishii, Tomio

AIR POLLUTION (ODOR) CONTROL FOR KRAFT PULP MILL WITH OZONE. (Taiki osen (shuki) to kurafuto parupu miru no ozon dasshu). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 7(9):824-828, Sept. 1971. 6 refs.

A pilot odorimeter was tested in 1970 in England wherein the upper part of the test tube had a heated coil which lighted mixed gas. The flame rapidly spread below and formed dispersed light. Sample gas was passed into the tube from the lower opening and through the burner at the speed of 7 m/sec; the light continuously scattered at the narrow point of the tube and reached the upper part of the water jacket which enveloped the tube. The intensity of the light was photoamplified and was sent to a penrecorder. At the test site, methylmercaptan was discharged for five minutes at a height of two meters from the ground, 100 meters windway from the measuring point. The record showed a wave pattern with six or seven large peaks, probably due to the breeze. But the test was deemed successful. In the United States, the Kraft Pulp Mill's deodorization process by ozone is an example of successful treatment of industrial odor problems. In the process of chemical digestion of pulp, hydrogen sulfide and methylmercaptan are emitted and create odor. According to a study, 1000 kg of pulp creates 114.2 g H2S and 824.1 g of mercaptan at the Kraft Pulp Mill. The main sources of emissions are the stacks of the black liquor combustion furnace; discharge from the digester; waste gas from the blowdown; and the non-condensable materials from the evaporator and vacuum pumps. Oxidation of the gas from the black liquor stack solved that particular problem, but the main source of odor was the blowdown which oxidation did not help. More recently, waste gases at this mill are treated through condensers where ozone is added to the gas at the entrance and exit, and has proved successful. The duration of gas-ozone contact is also important, and a 2.2 sec exposure gave the best result.

32799

Hirama, Masashi, Kazuo Murata, and Katsuji Ashida

MICROPOROUS THIN MEMBRANE, YUMICRON. (Bikosei usumaku yumikuron (Yumicron)). Text in Japanese. Yuasa Jiho (Yuasa Tech. Inform.), no. 36:33-45, Sept. 1970. 4 refs.

The Yuasa Battery Company has developed a special microporous thin membrane, Yumicron, made from various kinds of thermoplastic resins with extremely fine micropores. Those membranes which have very fine micropores show the characteristics of semi-permeable membranes such as cellophane. Other kinds of Yumicron are chemical-resistant, water repellent, heat-sealable, and also available for various uses as: battery separators, dialysers, diaphragms for electrolysis, deodorizer bags, artificial gills, artificial kidneys, and artificial lungs. (Author abstract modified)

32847

Aoyama, Mitsugu

WET TYPE ROTATING SCREEN CLEANING DEVICE AND LOW TEMPERATURE INCINERATOR. (Shisshiki kaiten sukurin seijo sochi oyobi teion nensho ro). Text in Japanese. Preprint, Reutilization of Resources Technical Assoc. (Japan), 6p., 1971. (Presented at the Seminar on Reutilization of Resources Technology, 2nd, Japan, July 12-14, 1971, Paper 3.)

A low temperature incinerator has been combined with a wet type rotating screen device in order to trap soot, smoke, harmful gases, and obnoxious odors. Two separate boards are fitted to a rotating axis within a drum and, between the two boards, there is a frame for the screen. A blower is at one end of the axis, with an inlet to suck in the polluted air and a discharge outlet and pipe on the opposite side. As the axis is rotated about 1000 times/min, the polluted air is caused to pass the screen. Steam, which is continuously emitted from the inlet, cleans the screen and traps the particulates. Trapped matter is neutralized with a caustic soda solution and disposed. Water from a tank is poured on the screen, and carbon which floats on the water in the tank is pumped up, dried, and recovered. High polymers are burned in one stage of the incinerator, then drop to the floor of a second incinerator and are again burned. An ignition device and a blower are attached. Carbon can be recovered.

32900

Nippon Sekiyu Co., Ltd. (Japan), Negishi Refinery

EXPLANATORY NOTE ON ACTUAL STATE OF PUBLIC NUISANCE CONTROL MEASURES. (Kogai boshi taisaku genkyo setsumeisho). Text in Japanese. 61p., July 1970.

Air pollution countermeasures adopted by a petroleum refinery are reviewed. The hydro-refinery process was adopted to eliminate the offensive odors and harmful gases emitted from waste liquor generated in the conventional process using chemicals (sulfuric acid or caustic soda). Sulfur recovery devices and a centralized chimney (130 m high) for effective smoke diffusion were installed. An air cooler, cooling water circulation system, and waste water stripper were adopted. Deodorizers packed with active carbon were positioned at various spots for odor control. Noise prevention and water treatment devices were also installed. Data are given on the detailed control measures, atmospheric diffusion of sulfur dioxide by season and under different meteorological conditions. Analysis of water pollutants, and effectiveness of the control equipment and processes.

32913

General Council for Industrial Pollution (Japan)

SUCCESSFUL CASES OF INDUSTRIAL PUBLIC NUISANCE CONTROL. (SUPPLEMENT). (Sangyo kogai boshi seiko reishu. (Tsuiho)). Text in Japanese. Preprint, 30p., May 1971. (Presented at the Industrial Technology Liaison Conference, Japan.) 2 refs.

Nine successful cases of industrial public nuisance control are presented, including three cases of air pollution control, five cases of waste water treatment, and one case of noise/vibration control. Sulfur oxides emitted in exhaust smoke were controlled using a catalyst type dry desulfurization process, with 96-99% efficiency for smoke containing 1500-800 ppm for sulfur oxides. A deodorization filter was designed for factory, hospital, home, and air coolers. A crucible furnace, partially modified by a small hole of 25-micron diameter in the lower part, reduced the smoke density, as determined by the Ringelmann smoke chart, without deterioration of combustion.

32935

Goldberg, Alexander S.

A PROCEDURE FOR TREATMENT AND DISPOSAL OF WASTEWATER SLUDGE. J. Water Pollution Control Federation, 43(9):1912-1920, Sept. 1971. 3 refs.

Traditional sludge stabilization or digestion has usually been biological, either aerobic or anaerobic, with all the problems inherent in any biological process. In September 1965, a series of experiments was begun with the aim of substituting a reliable chemical or physical process for the biological system of digestion. The dewatering problem was approached first. A study was made of the relative filtration rates of primary sludge, digested sludge, and activated sludge. Best results were consistently obtained with primary sludge. In order to eliminate odor, chlorine was added to the samples in various quantities to determine the strength at which the odor would consistently disappear; this point was approximately 500 mg/l Cl per percent of sludge solids. Several alternate oxidation methods were tried, and the use of sodium hypochlorite resulted in a suspension that was free of odor and the usual sticky grease. Because the chlorinated sludge behaved like a paper mill slurry, it was decided to use screens as a filtration procedure similar to the process used in the paper industry with papermaking machines. Two sources of sludge were used for experiments to convert sludge into a product suitable for manufacturing or agricultural uses. Costs are indicated.

32937

Gommi, J. V.

OPERATING PERFORMANCE OF A RECOVERY BOILER ODOR CONTROL SYSTEM. Tappi, 54(9):1523-1526, Sept.

1971. 2 refs. (Presented at the Technical Association of the Pulp and Paper Industry, Engineering Conference, Denver, Colo., Oct. 25-29, 1971.)

The air contact evaporator system was developed as a means of removing the source of the hydrogen sulfide odor in Kraft recovery furnaces. An air heater transfers the heat from the exiting gases to the incoming clean air; this heated clean air is then routed to a cascade evaporator where it removes moisture from the black liquor. The system retains and reinforces the operating philosophy which maximizes chemical conversion and recovery, and minimizes unburned fuel and sulfur emissions. This is achieved by proper attention to spray droplet size, hearth bed shape, primary to secondary air ratio, and sufficient secondary air pressure to take advantage of the tangentially fired turbulence available in the furnace design. Two contact evaporator systems are discussed and are operated below code requirements for toal reduced sulfur compounds. Operating problems are considered, as well as recent operating experience.

32956

VDI (Verein Deutscher Ingenieure) Kommission Reinhaltung der Luft, Duesseldorf (West Germany), Fachausschuss der Mineraloelindustrie fuer gas- und staubfoermige Emissionen

RESTRICTION OF EMISSION MINERAL-OIL REFINERIES. (Auswurfbegrenzung Mineraloelraffinerien). VDI (Ver. Deut. Ingr.) Richtlinien, no. 2440, May 1967. 8 refs. Translated from German. Israel Program for Scientific Translations, Jerusalem, 9p., May 1970. NTIS: TT 68-50469/15

Mineral-oil refineries give off dust and gaseous emissions, and the latter is of real concern. Hydrocarbons evaporate into the atmosphere when their vapor pressure exceeds 100 torr at the storage temperature. Other emissions include sulfur dioxide, hydrogen sulfide, mercaptans, and carbon monoxide (formed only in the regenerators of catalytic cracking plants). When atmospheric distillation (topping) separates the crude oil into fractions differing in evaporation behavior, methane, ethane, H2S, mercaptans, and other malodorous substances are formed. Further distillation can then take place with vacuum distillation, which produces olefines and sulfur oxides. The production of air-blown bitumen (oxidized asphalt), visbreaking, catalytic cracking, and reforming also produce various pollutants including H2S, phenols, mercaptans, and other malodorous sulfur and oxygen compounds. The reforming process often includes an H2S scrubbing stage. Desulfurizing by hydrogenation produces H2S which is removed by H2S scrubbing. The H2S is then returned to the process cycle. Gas separation is also used to produce propane, butane, H2S, and a residual gas of ethane-ethylene and methane. Lubricating-oil refining produces acid resins which vary in viscosity which can be eliminated by hydrogenation or the use of solvents in refining. Since hydrocarbons have a high vapor pressure, they should be stored in special tanks with floating-roofs or connecting a fixed-roof tank to an existing enclosed gas system. Blending can also reduce hydrocarbon emissions. Volatile hydrocarbons may also be emitted during pumping, processing, or through safety valves, but engineering design changes can eliminate this. Sulfur dioxide content must be taken into account in stack-height computation. Also, hydrogen sulfide can be eliminated by a Claus-kiln unit which converts it to elemental sulfur, which can be recovered and reused. Alkaline and acid waste water containing sulfur can be used for corrosion prevention or neutralized. Waste-water discharge systems, waste incineration, inspection, sampling, and waste gas emission are also discussed.

33003

Koyama, Yoshimasa

EXAMPLES OF ODOR COUNTERACTION MEASURES IN SEWAGE TREATMENT PLANTS. (Sesiso kojo ni okeru akushu taisaku no jisshi rei). Te in Japanese. Sangyo Kankyo Kogaku (Ind. Environ. Eng.), vol. 65-66:58-68, July 1969.

Methods of removing odors at a domestic sewage collection plant are described. Various solutions are presented for cases where odors escape from sewage intake ports despite air cutains, water films, and spraying of odor neutralizers. The elimination of odors from incineration plants, especially from garbage pits prior to incineration, is also examined. In addition, the OMK (?) deodorizing system is described. Waste gas is sprayed in the first chamber with an odor neutralizing solution. The gas is then stirred with the fan until more odorants are neutralized and foams are formed. The foamy gas is subsequently defoamed by in a water shower and the gas is then discharged. The actual application of the OMK system to a sewage collection plant is demonstrated and the results shown.

33073

Adalberto, Tirado A.

PROCESS DESIGN FOR POLLUTION CONTROL IN INDUSTRIAL PLANTS. Print, American Inst. of Chemical Engineers, New York and Inst. Mexicano de Ingenieros Quimicos, 13p., 1970. 6 refs. (Presented at the American Institite of Chemical Engineers, Institute Mexicano de Ingenieros Quimicos Joint Meeting, 3rd, Denver, Colo., Sept. 2, 1970.)

Principles of process design for pollution control in industrial plants were discussed. Modern process design must consider the plant and nature as a whole. The principles used to control odors in a Kraft pulp plants were given. Tendencies or potentials can only be modified by tendencies or potentials of the same nature. Material and energy balances are always true. Energy should tze used in a cascade. Internal recycling to change temperature, concentrations, flow rates, and equilibria without affecting the external energy and material balances is a useful tool in fighting pollution. In pulp mills, contaminated water is recycled to increase the recovery of fibers or other substances and, at the same time, save substantial quantities of water.

33077

Hein, Glen M. and Richard B. Engdahl

ON-SITE INCINERATION OF RESIDENTIAL WASTES. A. DOMESTIC DWELLINGS. In: Principles and Practices of Incineration. Richard C. Corey (ed.), New York, Wiley-Interscience, 1969, Chapt. 4, p. 74-83. 8 refs.

The simple household incinerator often used gas burners to ignite, dry, and burn the charge. A survey showed the most common complaints were caused by ashes around the burner, overloading the charging compartment, not burning the charge fast enough, not emptying the ashes, clogging the grates with unburnable materials, and improper charging and maintenance. These surveys led to research for smokeless, odorless, fly-ash-free units. Municipal refuse was analyzed and the heats of combustion for various substances were determined. Laboratory tests were used to develop two prototype incinerators. In the prototypes, combustion air and flue-gas-dilution air were used for cooling the jacket and flue gas. Also, combustion-air supply was controlled, and a separate supply was used for afterburning. Using a gas-fired afterburner, a 1500 F temperature was maintained and smoke and odors were completely oxidized. Impingement or change of flow direction and velocity reduction caused fly ash to drop out. Also, a barometric damper prevented excessive chimney draft. The ash-drawer capacity was 20% of the loading capacity, and burners and controls had easy access. Several multi-chamber incinerators are discussed along with their pollution potential, and are compared to gas- and oil-fired heating units and automobile exhaust. Stack emissions include aldehydes, nitrogen oxides, organic acids, ammonia, hydrocarbons, sulfur dioxide, carbon monoxide, and particulate matter.

33120

Ono, Shigeru

DEODORIZATION OF CLEANING FACILITIES. (Seiso shisetsu, chikusangyo no bo-dasshu taisaku). Text in Japanese. Yosui to Haisui (J. Water Waste), 13(9):1091-1106, Sept. 1971. 45 refs.

Odor producing sources and the amounts of odor from sewage treatment plants and related facilities, from waste disposal systems and related facilities, and from pig and poultry farms are discussed in detail. Methods of deodorization of vacuum cars, sanitation facilities, and pig and poultry farms are also discussed. The survey of vacuum car deodorization methods includes a table of currently available techniques such as adsorption by ion exchange resin, activated metal, and desalination by sulfonated carbon; masking by neutralizers, chlorides, and sewage mixture; combustion with fuel and thermal decomposition by propane gas; and other methods such as wet scrubbing and the use of low-speed rotating suction pumps to prevent dispersion of sewage. Thermal decomposition of sewage and dusts is usually achieved at 700 to 1200 C temperature. The combustion methods are effective when the odor content is high and the water content in the material is low. When combustion is incomplete, the result can be adversary; for instance, butanol will change into butyraldehyde or acetic acid and increase the odor. Ammonia does not burn in normal air, but will change into nitrogen oxides. According to experiments, sludge odor will decompose between 680-740 C. Among the low molecule fatty acids, acetic acid and propionic acid will decompose at 743 C and capronic and butyric acid at 778 C. Poultry extrate dryer exhaust gas requires 600 C for decomposition. The same gas treated in platinum black catalyst at 300 C reportedly has satisfactory results.

33122

Honda, Akihiro

FUNDAMENTAL METHODS FOR ODOR CONTROL. (Akushu boshi no kihonteki hoho). Text in Japanese. Yosui to Haisui (J. Water Waste), 13(9):1079-1090, Sept. 1971.

Of various basic methods of deodorization, those by (1) decomposition or solution and concentration or absorption; (2) chemical deodorants; (3) adsorption; (4) ion exchange; and (5) oxidation are discussed in detail. The first method includes water scrubbing apparatus of simple water washing; columns packed with coke, Raschig rings, pipes, or ceramic balls; step towers such as multi-perforation steps, mesh-steps, lattice-steps, air-jet steps, umbrella-steps, and floating balls; and special absorption towers such as waterfilm types and cyclone scrubbers. Temperatures for concentration of various odor producing elements are given. Chemical deodorants are discussed according to various classifications such as powders, liquids, and gases; organic and inorganic methods; methods such as direct application, surface covering, aerosol contact, flow-through; and mechanisms such as psychological (masking, neutralization), physical (solution, adsorption), and chemical (concentration, superimposition, oxidation, reduction, and disinfection). Tables of deodorization effects by direct and indirect applications of inorganic deodorants and deodorization mechanisms of organic deodorants are given. Tables for the adsorption capacity of activated carbon for various odor producing elements, room sizes that one pound of activated carbon will deodorize for one year, and necessary amounts of activated carbon per person per year for various classes of facilities are included. A table is presented showing the effectiveness of various ion exchange resins. Various methods of oxidation, such as ozone, chlorine, combustion, and bacteria are discussed.

33380

Koyama, Yoshimasa

NEUTRALIZATION OF ODOR BY DEODORANT. (Shoshuzai ni yoru shuki no chuwa). Text in Japanese. Kuki Seijo (Clean Air-J. Japan Air Cleaning Assoc., Tokyo), 9(3):21-27, Aug. 1971. 8 refs.

Various methods of deodorization are reviewed, including the difference between deodorization and elimination of odor producing material, neutralization of odor, and the masking method. Omi Brothers Co., Ltd. obtained the sales rights of airwick in Japan in 1952. Airwick is a neutralizer developed by Guy Pascal of Airkem in 1940, and is now used widely in Japanese homes and by commercial and industrial establishments. Several apparatus using airwick are introduced. The Aerosol deodorization apparatus used used at sewage treatment plants consists of an air compresser, a neutralizer forcing tank, and a spray gun. Another apparatus used at sewage treatment plants is the odor suction aerosol deodorizer, which consists of a scrubbing tank, a neutralizer aerosol tank, and a blower. The odor-containing air is sucked into the system and washed in the scrubbing tank where water-soluble material dissolves; the air comes into contact with the neutralizer in the aerosol tank, then is emitted into the atmosphere by the blower. Various types of airwick are recommended for various specific purposes and types of odor producing plants and facilities.

33398

Murahara, Masao

DEODORIZATION OF POULTRY EXCRETA BY BACTERIA PROCESSING. (Biseibutsu ni yoru keifun no dasshu-ho). Text in Japanese. (Assignee not given.) Japan. Pat. Sho 46-30764. 4p., Sept. 7, 1971. 2 refs. (Appl. April 25, 1967, claims not given).

A newly discovered bacillus MM-43, No. 552 can be separated from soil and cultivated in amino acid culture made from agricultural product waste. This bacillus has a characteristic of breeding and growing at a temperature of approximately 50 C and has a deodorizing ability. Amino acid dreg 250 g (water 70%, nitrogen 0.8%), 160 ml of water, 7.5g of slaked lime, and three ml of the bacilli are mixed and cultured for 42 hours. Fresh chicken feces, 500 g, is mixed in the culture. The odor will disappear as the mixture is stirred, and the excreta will stay odorless after it is dried.

33617

Miyahara, Kingo

COMBUSTION DEVICE FOR ODOROUS GAS. Text in Japanese. (Assignee not given.) Japan. Pat. Sho 46-23829. 2p., Aug. 17, 1971. (Appl. Dec. 9, 1963, 1 claim).

An odor control device is described which comprises a suction section, a duct section, and a mixing/combustin section. The built-in blower sucks in the odorous gases together with air, then mixes them with an auxiliary fuel gas, and noiselessly burns the mixture for the removal of the odor. The mixing/combustion section is a box-like case with a vane wheel installed at its entrance and a burning element at the exit.

33742

Nakajima, Kazuo

ODOR CONTROL BY UOP CATALYTIC COMBUSTION SYSTEM. (Shokubai nenshoho ni yoru akushu jokyo). Text in Japanese. Kuki Seijo (Clean Air - J. Japan Air Cleaning Assoc., Tokyo), 9(3):13-20, Aug. 1971.

The UOP catalytic combustion system, developed some 20 years ago by the Catalytic Combustion Company (presently called Universal Oil Products, Air Correction Div.), is discussed with the use of flowsheets and tables. The catalysts are thin ribbons of refractory alloys of nickel group metals used as carriers and those of platinum group metals used as activators. They are highly conductive, durable, light, and adaptable to variation of gas concentrations. The amount of catalyst is determined by the amount of exhaust gas. Among some 20 kinds of catalytic elements, the D-2 type, which treats 16 N cu/min is the most popular. Catalytic toxin producing metals are mercury, lead, tin, and zinc. When catalysts receive damages by the steam of these material, recovery of catalysts at the manufacturer s plant is necessary. Also, when halogen (fluoride, chlorine, or bromine) exist in exhaust gas, catalytic activity will decrease; dust, soot, mud, rust, oxidation, organic potassium compounds, and many other causes may lower the activity, and the catalysts may require washing or rejuvenation. However, except for special catalytic toxic reactions, washing on the plant site once or twice a year will insure at least three to five years of functioning, and with two or three rejuvenations at the manufacturer s plant, catalysts should have approximately 10 years of life. One advantage of this system is its capacity of heat recovery. Exhaust gases from enameling, plating, or baking furnaces contain solution steam that is combustible. Successful examples of heat recovery are presented.

33793

SEWAGE SLUDGE BURNED WITHOUT SMOKE OR ODOR. Public Works, 102(10):72-74, Oct. 1971.

In San Mateo, California, the city engineers solved the problem of disposing of sewage sludge by installing an incinerator system. A multi-hearth furnace, fueled with natural gas, reduces 25 tons of sludge cake per day to one ton of dry, sterile ash. Long-range plans for the treatment plant include a proposed full secondary treatment system and eventual tertiary system to reclaim wastewater for municipal parks and recreation facilities. Solids and other materials are shredded by two comminutors at the main lift station, and the sewage is then prechlorinated to control odor and reduce BOD and coliforms. The sewage is first pumped into three clarifiers for settling and separation of solids and liquids. Floating grease and skimmings are removed by a surface scraper and gravity-fed into a pit for subsequent pumping to the natural gas sludge incinerator. During the combustion process, all fumes and odors are destroyed thermally.

33816

THE INSTALLATION OF HONEYCAT SYSTEMS. Platinum Metals Rev., 15(4):132-133, Oct. 1971. 2 refs.

The Honeycat air pollution control system depends on catalytic combustion converting organic vapors, the main cause of most factory smells, to non-smelling and harmless carbon dioxide and water. Effective odor abatement may be obtained with the Honeycat platinized ceramic honeycomb catalyst at operating temperatures of about 50% of those required in direct incineration systems. The system is already being applied in the animal by-products, food manufacturing, and fish meal industries. The critical factors that affect the solving of air pollution problems of this type are the composition, temperature, and volume of the process gas to be treated.

33854

Bachmair, Anton

REPORT ON LECTURE GROUP F OF THE CONGRESS REINHALTUNG DER LUFT 1969. Staub (English translation from German of: Staub, Reinhaltung Luft), 30(2):26-35, Feb. 1970. 18 refs. NTIS: TT 70-50047/2

Summaries are presented of lectures on odors, waste incineration, and domestic fuels. Odors are reduced by thermal waste-gas purification, catalytic waste-gas purification, and chemical oxidation; data is included on the efficiency of these processes as used in the food industry. The state of the art of reducing emissions from waste incineration is described, and regulations covering large and small incinerator plants are noted. Smaller plants use primarily mechanical separators; large plants, electrostatic precipitators. Proposed processes for removing sulfur dioxide from smoke are not yet suitable for practical use in waste incineration. With the increased use of gas and electricity, emission of solid matter from domestic furnaces will drop by approximately 50% in the next 10 years, but SO2 emissions will increase with the increased use of oil for domestic furnaces. Five processes for producing fuels which emit little smoke are described: the Inichar-sand-bed furnace process, the alkali briquette-making process, the BF-sanding coking processes for smoldering anthracite briquettes and coal pellets, and the hot briquette-making process.

34073

Ito, Norio, Masao Shimoda, and Hideo Takahashi

EFFECTIVE SLUDGE TREATMENT TECHNIQUE AND ITS COST. (Hedero no kokateki shori gijutsu to sono hiyo). Text in Japanese. PPM (Japan), 2(9):58-61, Sept. 1971.

Quicklime is an effective agent for the treatment of sludge containing hydrogen sulfide. When the flow velocity of the H2S is five l/min or lower, 250 ppm H2S can be reduced to 0 ppm. The H2S gas can be completely absorbed when the ratio of the thickness of the quicklime layer to the flow velocity is larger than or equal to three. X-ray diffraction analysis of the quicklime after absorbing the H2S confirmed the formation of slaked lime and calcium sulfide. The odor peculiar to H2S gas was completely removed when 100 g quicklime were added to 10 kg sludge, then stirred at 50 rpm for five min. One ton of quicklime is enough to control half a million cu m of sludge.

34385

Kalish, John

EUROPE S LARGEST KRAFT DIGESTER COMES ON STREAM AT BILLERUD. Pulp Paper Int., 13(11):51-55, Oct. 1971.

Europe s largest continuous kraft digester -- rated at 940 tons/day -- and a highly advanced evaporation and cross-recovery system highlight the recently completed kraft pulp expansion at the Gruvon mill of Billerud AB in Sweden. About half of the output of the new digester is flash dried market pulp from twin 275-ton/day flash dryers, marking Billerud s entry as a producer of unbleached kraft market pulp. Environmental and emission control at Billerud centers around a very well designed recovery system with several unique features for optimal operation and odor reduction. A new technique of splitting the condensates from the black liquor evaporation stages has been employed to isolate contaminated condensates and provide for subsequent destruction of the contaminants. The two present evaporator lines are attached to a 20-ton/hr forced circulation stage for concentration of the thick liquor to 65% solids, considered to facilitate subsequent combustion. Sodium hydroxide is added to the first stage of the stack gas scrubber. The recovery boiler and other details of the recovery system are described. (Author summary modified)

34679

Carruthers, J. D.

WEB OFFSET PRESS AIR POLLUTION: HOW SERIOUS IS IT? Inland Printer/Am. Lithogr., 167(1):50-51, April 1971.

Thermal incineration systems are not suitable to pollution control in printing plants. Experiments were conducted using a gas chromatograph with a mass-integral detector to analyze both quantitatively and qualitatively the exhaust from two 38-in. web presses. Two kinds of heat-set ink containing 20-30% solvent were used on two kinds of stock, gloss-coated and matt-coated no. 45 paper. Analysis of the ink solvent showed mainly C11-C12 hydrocarbons. Increasing the amount of flame drying produced substantial changes. First, the high boiling hydrocarbons completely disappeared from the exhaust. Second, a low-boiling fraction of C3 to C9 hydrocarbons appeared. A change in the kind of paper also produced a noticeable change in the effluent. The glossy paper promoted burning and cracking of the solvent on the web. Consequently, fewer high-boiling hydrocarbons were emitted. The opposite effect was observed for the matt-coated paper. These results indicate that by adjustment of heat in the dryer, smoke and odor problems from high-boilers and low-boilers, respectively, can be controlled.

34778

Timby, E. A.

AIRFLOW RATE REQUIREMENTS IN PASSENGER AIRCRAFT. Royal Aircraft Establishment, Farnsborough (England), Engineering Physics Dept., Ministry of Aviation Supply Current Papers 1136, 27p., 1970. 15 refs. NTIS: N71-20849

Airflow requirements for cabins of passenger transport aircraft are considered from the aspects of breathing, temperature control, odor control, pressurization, and equipment cooling. In supersonic aircraft the consequences of a pressurization failure and the requirements of equipment cooling are likely to prevent much reduction in airflow below current figures. The present fresh airflow rate is specified as 1.2 lb/min per passenger during flight and 0.5 lb/min during taxi conditions. In subsonic aircraft the airflow could be reduced for pressurization but is likely to be dictated by odor control on which information is lacking under representative conditions. The minimum engine air bleed rate would occur for a system which recirculates and purifies a proportion of the cabin air. Development of cabin air distribution systems would be required if airflow is to be reduced. Odors can be removed by adsorption, scrubbing, and masking. (Author summary modified)

34868

Duncan, Leon and Isaiah Gellman

THE AIR POLLUTION CONTROL PROGRAM OF THE NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT. Vanderbilt Univ., Nashville, Tenn. Dept of Environmental and Water Resources Engineering, and Tennessee Stream Pollution Control Board, Environ. Water Resources Eng. Conf., 9th, Annu., Nashville, Tenn., 1970, p. 41-44. (June 4-5.)

During the past 15 years, the National Council of the Paper Industry for Air and Stream Improvement has been actively engaged in a research program aimed toward air quality protection. These efforts encompass such areas as development and application of sampling and analytical techniques, adaptation and evaluation of air pollution control equipment, changes in processes and operations to effect improved atmospheric emission, and applications of new concepts in pulp and paper making operations for more effective emissions control. Currently, the major thrust is in the area of odor control from kraft mill operations.

35554

Klein, Nicholas

SMOKE CLEANING APPARATUS. (Assignee not given.) U. S. Pat. 3,582,051. 7p., June 1, 1971. 4 refs. (Appl. Jan. 8, 1969, 10 claims).

Previous apparatus for reducing air pollution caused by smoke discharging furnaces and incinerators has been limited to filters of various kinds, generally screens placed at outlets of chimneys. These filters have not been satisfactory because they quickly become clogged and ineffective. Electrostatic precipitators have limited applications since they are complex, expensive, and most suitable for extremely fine particles. In the present process, smoke bearing large particles is first passed through a conical baffle assembly made of closely spaced overlapping rings at the bottom of a smoke stack or chimney. The conical baffle assembly holds back larger particles which fall back to the furnace for reburning and removal via cleanout doors in the furnace. The smoke then passes through helical baffles in which an apertured spray pipe sprays water to cool the smoke and fumes and entrap more particles in the smoke. The dirty water flows down to the conical baffle and is then drained off to a sewer or filter tank and recirculating pump. The cleaned smoke is then deodorized by a sprayed deodorant and passes up out of the chimney to the atmosphere.

35566

Shieh, Wen-shong and Robert H. Essenhigh

EXPERIMENTAL BEHAVIOR OF WASTE COMBUSTION IN A TEST INCINERATOR. Preprint, Delaware Univ., Newark, 31p., 1971. 20 refs. (Presented at the Mid-Atlantic Industrial Waste Conference, 4th, Newark, Del., Nov. 18-20, 1970.)

Experiments on waste combustion in a test incinerator are examined with respect to incinerator design, instrumentation for analysis and determination of emissions, operational procedures, and results. Smoke, fly ash, and odoriferous or noxious gases were emitted in the process. The countervortex system of overbed air supply was capable of generating a stirred-reactor flame-holder for the overbed flame, which could be maintained only above some minimum rate of fuel and air supply. The fuel for the overbed flame was mainly a product of pyrolysis. When the overbed flame was absent, the prime source of heat for pyrolysis was the convective heating from the bed. When air rich was burned, the overbed flame was clean, but when fuel rich, it emitted smoke. With a sufficiently hot overbed flame, radiation alone would be sufficient for total pyrolysis, thus minimizing fly ash emissions. (Author conclusions modified)

35595

McCabe, Louis C.

SANITARY ENGINEERING ASPECTS OF ATMOSPHERIC POLLUTION. J. Sanit. Eng. Div. Proc. Am. Soc. Civil Engrs., vol. 80:392-1 to 392-4, Jan. 1954. (Presented at the American Society of Civil Engineers, Annual Convention, New York, Oct. 21, 1953.)

The sanitary engineer has extensive experience with air pollution problems, notably waste disposal and odors. The need for odor control in industries which process dead animals may be greater than in the packing plants which are preparing food for human consumption. Some of the rendering plants in the Los Angeles area have used venturi jet condensers successfully but most rely on incineration to abate odors. Lack of cleanliness in maintenance may also account for odors around rendering plants. The greatest source of malodors in oil refineries are mercaptans which contain sulfur and are commonly derived from high sulfur crudes. Mercaptans may be removed from petroleum products by treating in a variety of processes, practically all of which utilize caustic action. Paint and varnish plants may discharge highly irritating substances such as acrolein, aldehydes, and fatty acids from their processes. Incineration of domestic household waste and garbage is generally not a sure means of eliminating odors in air pollution. Poor design, intermittent operation, and the character of the waste material are responsible for unsatisfactory operation. It is also recognized that hydrocarbons in the air may be oxidized to produce compounds which will damage growing crops and cause eye irritation. Some control equipment for dust, smoke, and fumes are noted.

35609

Lorentz, Fred

A CHEMICAL PLANT s SOLUTION OF AERIAL POLLUTION AND WASTE DISPOSAL. Chem. Eng. Progr., 46(8):377-379, Aug. 1950.

The principal potential air pollution offense at a New Jersey pharmaceutical plant arises from a few steps in the vitamin B1 synthesis where the production and handling of sodium dithioformate is involved. The vapors have a garlic-sulfide stench. Activated carbon is the most effective method of arresting the airborne odors which cannot be easily destroyed by chemical scrubbing solutions. The odor adsorption system consists of a low speed exhaust fan drawing 12,000 cu ft/min of air at three-eighths-in. standard pressure through a manifold duct system connected to the vents of about 15 pieces of equipment, all handling the malodorous intermediates. This method is convenient to operate and has a high capacity resulting in a fairly long adsorbing cycle. Flexible design of an incinerator makes it possible to dispose of large quantities of a wide variety of liquid and solute wastes in a completely innoxious manner, even to the extent of disposing of objectionable aqueous solutions.

35660

Lardieri, Nicholas J.

PRESENT TREATMENT PRECTICE OF KRAFT MILLS ON AIR-BORNE EFFLUENTS. Paper Trade J., 142(15):28-33, April 14, 1958. 7 refs.

A survey was conducted to ascertain what methods are used for treatment of atmospheric effluents from kraft pulping mills; 58 mills participated. The types of recovery equipment used, specific abatement techniques for various effluents, costs of abatement processes, and the public relations aspects of the problem were considered. The equipment used for collection of particulate matter and aerosols from recovery furnace stacks included electrostatic precipitators (50 mills) and venturi scrubbers (nine mills) two mills used no equipment whatever. Wet scrubbers were used by 54 mills and dry dust collectors by one to control lime kiln exhaust; one mill did not use any control equipment. Odorous emissions from the kraft industry occur primarily from digestion and chemical recovery. Some reduction in these emissions from digester gases is achieved in most Southern kraft mills through the turpentine recovery system. Odors from the black liquor recovery systems arise from the multiple-effect evaporator condensates and from furnace stacks. Methods used to abate odors from these sources are scrubbing of evaporator noncondensables with caustic or black liquor, air oxidation of black liquor prior to recovery, and odor-masking of catalytic reactant compounds. Capital costs are about $1000. per ton of productive capacity.

35803

Miyajima, Hiroshi

TREATMENT OF EMISSION GAS FROM RECOVERY BOILERS. (Kaishu boira no haigasu shori ni tsuite). Text in Japanese. Nenryo Oyobi Nensho (Fuel and CCombustion), 38(12):1161-1176, Dec. 1971.

The emission gas from the recovery boiler of a Kraft pulp mill enters an electrostatic precipitator and approximately 95% of eight to ten g/N cu m size dusts are collected. The gas then enters a wet cyclone scrubber and most of 0.4 - 0.5 g/N cu m size dusts are collected and some 0.15 to 0.2 g/N cu m dust particles remain. Altogether, 98 to 99% of the dusts are collected. The dusts are collected mostly by colliding with the spray liquid in the scrubber or diffusing or adhering to the surface of the liquid. The characteristics of this scrubber are its simple structure, easy operation, cleansing operation without power, little draft loss, a wide design possibility for a variety of particle sizes, types, and quantities, a small space requirement, a high collection rate of small particles, its multi-functions, and an excellent anti-erosion capacity. The odor is controlled by an alkaline solution additive in the scrubber liquid which absorbs hydrogen sulfide and mercaptans. The carryover of the dusts from the recovery boiler is successfully prevented by avoiding overloading, increasing the concentration of the black liquor, reducing the inorganic elements in the liquor, reducing the first air supply to the minimum, and decreasing the black liquor jet pressure.

35879

Ludington, David C., Albert T. Sobel, and B. Gormel

CONTROL OF ODORS THROUGH MANURE MANAGEMENT. Trans. ASAE (Am. Soc. Agr. Engrs.), 14(4):771-774, 780, July-Aug. 1971. 2 refs. (Presented at the American Society of Agricultural Engineers, Winter Meeting, Chicago, Ill., Dec. 1969, Paper 69-936.)

Two different experiments were conducted to check the influence of moisture removal and manure removal on the odor offensiveness of the gases released from chicken manure. An odor panel was used to evaluate odor offensiveness. Results showed that removing moisture reduced the odor level. Diluted manure always produced the highest offensiveness and undiluted manure the next highest. Daily scraping, which did not allow for buildup of manure, also successfully controlled odor. A manure management system which either removes the manure from the building at least daily without manure buildup or removes moisture from the manure will cause a minimum amount of air pollution by the release of odorous compounds. (Author summary)

35955

Howorth, Frederic Hugh

APPARATUS FOR FILTERING POLLUTED AIR. (Appareil pour filtrer de l air pollue). Text in French. (Howorth (James) and Co. Ltd, Bolton (England)) Swiss Pat. 503,511. 3p., April 15, 1971. (Appl. Sept. 10, 1968, 5 claims).

An apparatus is described for removing impurities such as dust, sludge, and oily or tarry particles from polluted air drawn either from working premises or from the open atmosphere, and projected through a conduit. Inside the conduit, two sheet filters made of porous plastic material and supported by frames are mounted in parallel a short distance from each other at an angle of 45 deg to the center line of the conduit. As the air flows through, the particles are trapped by the first filter, and are washed down by a water spray from a perforated tube located ahead of the filter. The polluted spray water is collected in a receiving tank attached to the underside of the conduit. From there the liquid flows by gravity into a sump tank which comprises two compartments, separated from each other by an overflow partition wall. The first compartment provides for settling and sedimentation, and is designed to permit periodic removal of the sludge and replacement with clean water. The second compartment receives the clear overflow water, to which a deodorizing detergent solution is added; the detergent is selected depending on the source of the polluted air. The cleaned water is returned to the spray system and thus re-used in a closed cycle. The air that has passed through the first filter carries a substantial amount of humidity which forms into droplets on contact with the second filter in the conduit; the droplets fall back onto the first filter and are thus returned to the water collecting system. After passing through the second filter, the air is only slightly more humid than it was on entering the apparatus.

C. MEASUREMENT METHODS

00178

N. A. Huey, L. C. Broering, and C. W. Gruber

ODOR MEASUREMENT TECHNIQUES II (SECOND YEAR FINAL REPT.) Cincinnati Dept. of Safety, Ohio, Bureau of Air Pollution Control and Heating Inspection. Dec. 1959. 42 pp.

A brief review of instrumentation developments, and odor detection and measurement problems is presented. Odor strength measurement research involved the development of scentometer instrumentation, the 1959 Model and the 1959A Model; investigation of the Liquid Dilution Method; and studies of human odor detection abilities. Odor source detection research included the studies of meteorological equipment, meteorological data, complaint analysis, and investigation procedures.

00965

R. Cederlof, M. L. Edfors, L. Friberg, and T. Lindvall

ON THE DETERMINATION OF ODOR THRESHOLDS IN AIR POLLUTION CONTROL - AN EXPERIMENTAL FIELD STUDY ON FLUE GASES FROM SULFATE CELLULOSE PLANTS. J. Air Pollution Control Assoc., 16(2):92-94, Feb. 1966.

From the hygienic point of view, not only the health hazards caused by air pollutants but also the odor from emitted flue gases should be reduced to a minimum. An effective control of the risk of odor at ground level presupposes knowledge of the source concentration of the odoriferous gas as well as its odor threshold has to be estimated empirically, as the flue gases often contain a complex mixture of different odoriferous substances, the odor thresholds of which are in most cases unknown. For this purpose a method has been developed for estimating the odor thresholds of flue gases emitted from different industrial processes. The method, a field method, is based on an exposure procedure, a number of subjects compare different concentrations of the flue gas with samples of fresh air and decide at what concentration the flue gas is no longer noticeable. The gas samples used are neither compressed, nor absorbed or heated before the exposure test. The method has been used in two studies on gases from Swedish sulfate cellulose plants. In order to estimate the effect on the odor threshold of different deodorizing measures, gas samples were taken not only from the stack but also from different phases in the production process. The results and a brief discussion on the practical applications of the method are given. (Author abstract)

01289

M. Feldstein, S. Balestrieri, and D. A. Levaggi

STUDIES ON THE GAS CHROMATOGRAPHIC DETERMINATION OF MERCAPTANS. J. Air Pollution Control Assoc. 15(5):215-7, May 1965. (Presented at the Sixth Conference on Methods in Air Pollution Studies, California Dept. of Public Health, Berkeley, Calif., Jan. 6-7, 1964.)

A series of partitioning agents were studied to determine their ability to separate organic sulfur compounds by gas chromatography. Several columns showed promise, but did not separate organic sulfur compounds from normally occurring atmospheric hydrocarbons. Higher concentrations of organic sulfur compounds in stack gases are separated as metallic salts in a series of impingers. The nature of the precipitated sulfur compound can be determined by gas chromatography after regeneration of the compound by addition of acid to the metallic precipitate. (Author abstract)

02786

R. H. Linnell and W. E. Scott

DIESEL EXHAUST COMPOSITION AND ODOR STUDIES. J. Air Pollution Control Assoc. 12, (11) 10-5, Nov. 1962.

Some of the techniques being used and evaluated for exhaust analysis are outlined. Results except for some qualitative and tentative findings are shown in tables 1-8. Most values are averages of 2 or 3 determinations. These determinations were made on new samples taken at different times, with intervals of several weeks elapsing in some cases. Particulate matter information in table 1 indicates organic compounds adsorption. This is of interest in eye irritation and odor work since aldehydes may be present on particulate matter in higher concentrations than are present in the gas phase. The CC14 extracts of particulate matter show infrared bands characteristic of hydrocarbons, olefins, aldehydes, and carbonyl. Comparison of hydrocarbon measurements, formaldehyde and acrolein, and miscellaneous compounds are discussed. 26 references.

03010

H. Devorkin, R.L. Chass, A.P. Fudurich, C.V. Kanter

SOURCE TESTING MANUAL. Los Angeles County Air Pollution Control District, Calif. 181 pp., Nov. 1965

Specialized methods and techniques for the curtailment of contaminants being released into the atmosphere, developed in the laboratory and in the field are described in this manual. These methods are concerned primarily with the measurement of emissions from stationary sources, and in general, with little or no modification, these methods can also be used for testing vehicles or other moving sources. Information obtained form source tests is invaluable as a guide in selecting appropriate control equipment and improving the design of future installations to minimize the discharge of air contaminants. Following topics are discussed: Planning a source test; Determination of gas flow rate; Collection and analysis of particulate matter, and of gaseous constituents; Odor measurement; Source test report. The appendixes deal with rules and regulations, conversion factors and constants, and auxiliary field sampling equipment.

03354L

J. H. Sullivan, D. H. Robertson, and C. Merritt, Jr.

THE DETERMINATION OF THE VOLATILE COMPONENTS OF FOODSTUFFS. III. COFFEE AROMA. Quartermaster Research and Engineering Center, Natick, Mass., Pioneering Research Division. (Research Report Analytical Chemistry Series No. 12.) (Presented before the Division of Agricultural and

Food Chemistry, 135th National Meeting, American Chemical Society, Boston, Mass., Apr. 1959.) Sept. 30, 1959. 16 pp. CFSTI DDC 636331

Mass spectrometric analysis has led to the identification of several components of coffee aroma. The volatile compounds from ground roasted coffee are collected by distillation under high vacuum at room temperature into a receiver at liquid nitrogen temperature. Direct fractionation of a 'center cut' on the mass spectrometer and subsequent analysis has shown the presence of more than twenty compounds. Among the compounds identified are furans, aldehydes, esters, alcohols, nitriles and sulfur compounds. The techniques which have been used offer the following advantages: (1) The method of collection by vacuum distillation in a closed system is superior to other methods of collection. (2) A minimum of sample handling reduces greatly any loss of material. (3) Direct analysis on the spectrometer permits a complete qualitative analysis in a rapid, efficient manner and also provides for the extension to quantitative analysis, if desired. (Author abstract)

03542L

L. Reckner, F. R. Taylor, W. E. Scott, H. J. Wimette

DIESEL EXHAUST COMPOSITION, ODOR AND EYE IRRITATION (PROGRESS REPORT MAY 1, 1962 TO FEB 15, 1963. Preprint 1963.

Further work with the two-cycle 6-cylinder V-type diesel engine is reported which which covers solid and liquid particulate emissions at various operating conditions, odor intensity and eye irritation observations by a human panel at three operating conditions, analyses of the particulate for polycyclic aromatic hydrocarbons and further analyses of the gaseous emissions by long-path infrared and colorimetric techniques. A number of polycyclic aromatic hydrocarbons, including benzo(a)pyrene and several other compounds with reported positive biological activity, have been detected in diesel exhaust by fluorescence spectroscopy. The concentrations of most polycyclics were highest from 1/2 load to 7/8 load with a sharp decrease from 7/8 load to full load. The benzo(a)pyrene concentration found in diesel exhaust (0.6 to 7.4 micrograms per cubic meter) were lower than the 8.5 micrograms per cubic meter recently reported for automobile exhaust, but the diesel produced more benzo(a)pyrene (0.15 to 1.3 milligrams) per gallon of fuel than the automobile (0.27 milligrams). Fluorescence analyses of new and used lubricating oil and the rate of oil consumption indicate that the contribution of the oil to the exhaust particulate of this engine is negligible. Values for the emissions of nitrogen dioxide have been revised downward as a result of using an improved sampling technique which minimizes the oxidation of nitric oxide to nitrogen dioxide. Of the three engine operating modes studied, the odor intensities and eye irritation observed by the human panel were lowest at the 1200 RPM-1/4 load condition. It is believed at this time that the eye irritation from the exhaust can be accounted for by the formaldehyde and acrolein found in the exhaust. There is no clear-cut correlation, however, between the concentrations of these aldehydes and the odor differences observed.

03789

J. S. Leonard

STACK EMISSION SAMPLING. TAPPI 49, (10) 84A-85A, Oct. 1966. (Presented at the Shipley Award Program, Pacific Section, Technical Association of the Pulp and Paper Industry, West Linn, Oreg., Mar. 15, 1966.)

Potential air pollutants in kraft pulping emissions consist essentially of solid particulate and sulfur containing malodorous gases. The solid particulate is generally of a caustic nature, whereas the malodorous gases are of an acidic nature. In an effort to monitor these emissions effectively, a series of emission sampling stations and specialized sampling devices have been constructed. The particulate sampling device operates on an electrostatic precipitation principle and allows for the simultaneous sampling of solid particulate and malodorous gases. Four sampling stations are located on vertical stacks, at least five diameters downstream from obstructions. Sheltered work areas are provided with electricity and compressed air. (Author abstract)

04117

F. R. Rehm

TEST METHODS FOR DETERMINING EMISSION CHARACTERISTICS OF INCINERATORS (INFORMATIVE REPORT NO. 2). J. Air Pollution Control Assoc. 15, (3) 127-35, Mar. 1965.

In considering the problem of incinerator air pollution emission characteristics, early attention must be given to defining the type discharges which are of greatest concern. At this time the following 3 categories of incinerator effluents-visual emissions (smoke), particulates, and odor are of primary interest. It is in these 3 areas that the greatest present need exists with respect to air pollution performance evaluation standards or limitations and standardized test methods. It is toward the standardization of testing of these 3 classes of incinerator effluents that this report is pointed. Visual Emission Testing: Until some better tool evolves, the Ringelmann Chart will undoubtedly serve as the most frequently used method for assessing visual smoke emissions from incinerators and other combustion equipment. In recent years refinement of techniques has allowed for the grading of colored effluents other than black or white. Other applications in this category have included paper tape filters and photoelectric devices. Odor Testing: A 1961 Performance Evaluation Sub-Committee survey disclosed that only a limited amount of work has been conducted on odor testing of incinerator effluents. The human nose has been relied upon to a great extent. The ASTM Standard Method for Measurement of Odor in Atmospheres (Dilution Method) D 1391-57 involves sampling the gas for which the odor is to be measured and then diluting it with odor-free air until an observer can barely perceive the odor. Particulate Testing: This has involved various approaches to attain the following: (1) a representative sample of gas and suspensoid from a main gas stream; (2) filtering the particulates from the sampled gas stream; (3) accurately measuring the sampled gas volume; (4) measurements to assess total emission characteristics - temperature, pressure, gas velocity, composition, molecular wt, density. In summary, it is the Performance Evaluation Sub-Committee's opinion that the ASME Test Codes PTC 21-1941, 'Dust Separating Apparatus' and PTC 27-1957, 'Determining Dust Concentration in a Gas Stream,' with modifications and additions as discussed, could form the basis of an acceptable standardized test method for determining incinerator particulate emission characteristics.

04883L

National Council for Stream Improvement, New York City.

A MANUAL FOR DIRECT GAS CHROMATOGRAPHIC ANALYSIS OF SULFUR GASES IN PROCESS STREAMS. (Atmospheric Pollution Technical Bulletin No. 30.) June 1966. 27 pp.

The attached bulletin presents a detailed method for sampling and gas chromatographic analysis of kraft mill gases at their sources. This bulletin supersedes Bulletin 13, September 26, 1960, which is obsolete and is no longer recommended. In this new, simplified method, source samples may be taken either in evacuated pressure bottles, plastic bags, modified McLean tubes, or directly in gas-tight syringes. A small volume of the source gas (0.02 - 2.0 ml.) is injected directly onto the chromatographic column in a temperature-programmed oven. The eluted sulfur compounds are detected with a bromine, microcoulometric titration cell. The instrumentation and methodology were field tested at a West Coast kraft mill. Approximately 20 minutes is required to complete a single analysis for sulfur compounds ranging in molecular weight from hydrogen sulfide through dimethyl disulfide or higher. The rapidity of the analytical technique permits rapid qualitative and quantitative determination of the components of gaseous sulfur emissions from all sources, determination of the effectiveness of various odor control processes, and evaluation of the effect of changes in mill operating conditions upon quantity and type of emissions. (Author abstract modified)

05170

F. G. Rounds, and H. W. Pearsall

DIESEL EXHAUST ODOR (ITS EVALUATION AND RELATION TO EXHAUST GAS COMPOSITION. Vehicle Emissions (Selected SAE Papers) 6, 45- 69, 1964. (Presented at the National Diesel Engine Meeting, Society of Automotive Engineers, Chicago, Ill., Nov. 1-2, 1956, Paper No. 863.)

Techniques, based on panel estimates, were developed for evaluating the odor and irritation intensities of undiluted Diesel engine exhaust gases or of various dilutions of these gases in air. Along with the estimates, chemical analyses were made to determine the concentrations of total aldehydes, formaldehyde, and oxides of nitrogen. Statistically significant correlations were found between odor or irritation intensity estimates and the analytical data, but these correlations were too weak to permit accurate prediction of odor or irritation from chemical analyses. The effects of some engine variables on Diesel odor were studied. Possible means of reducing Diesel odor are discussed. Limited studies indicated that engine load has a pronounced effect on exhaust odor and irritation intensity. Engine make, engine speed, engine condition, fuel type and lubricating oil type had comparatively little effect.

05396

Turk, A.

APPROACHES TO SENSORY ODOR MEASUREMENT. Ann. N. Y. Acad. Sci. 116, (2) 564-6, July 30, 1964.

A critical evaluation is given of the method by which stimulus odorant concentrations are established. The use of tracer methods to monitor gas dilution is discussed. Two methods suggested for the reproducible presentation of odor stimulation to subjects from small containers are the equilibrium sniffer and the steady-rate sniffer.

05426

Adams, D. F.

LIMITATIONS IN ANALYSIS OF MALADOROUS, SULFUR-CONTAINING GASES IN THE AMBIENT AIR. Preprint, Washington State Univ., Pullman, Research Div., 12p., 1967. 45 refs.

The lead acetate impregnated tape method yields low and variable hydrogen sulfide concentrations. The ultramicro collection of ppb levels of hydrogen sulfide with the recommended cadmium hydroxide suspension is subject to approximately 50-80% loss of added hydrogen sulfide during and following air aspiration in midget impingers. The methylene blue colorimetric analysis procedure for hydrogen sulfide collected in cadmium hydroxide appears to be satisfactory. Static techniques for hydrogen sulfide, including exposured lead acetate tiles, lead-base painted panels and silver plated plaques, can not provide adequate information relating exposure duration and sulfide concentration. The plasma emission spectrometer is inherently the most versatile of the new instrumental methods of analysis because of its response to specific intramolecular bonds. Its present sensitivity is approximately two-three orders of magnitude above the odor-detection thresholds for the malodorous sulfur-containing compounds and its application may be limited to organic sulfur-containing compounds in the absence of air. The flame ionization detector provides the greatest sensitivity for organic, sulfur-containing compounds. Unfortunately, the F.E.D. responds to all organic compounds and thus the detector must be associated with a separation mode such as a gas chromatographic column. Several orders of magnitude of detector sensitivity are thus lost because of the column losses in the parts per billion concentration range. The F.I.D. sensitivity is inadequate for inorganic sulfur-containing gases and thus does not provide an all-purpose sulfur gas detector. Similarly, the E.C. detector must be used with a chromatographic column and thereby loses its inherent sensitivity. The most sensitive, all-purpose sulfur-gas instrumentation presently available is the bromine coulometric microtitration cell with an instantaneous sensitivity of approximately 5 ppb. When used with chemically treated membrane pre-filters, the microtitration cell provides a sequential, five-step record for total sulfur, SO2, H2S, mercaptans and alkyl sulfides and disulfides.

05503

C. F. Denmead

AIR POLLUTION BY HYDROGEN SULPHIDE FROM A SHALLOW POLLUTED TIDAL INLET, AUCKLAND, NEW ZEALAND. Proc. Clean Air Conf., Univ. New South Wales, Vol. 1, 20p., 1962, Paper 4.

Gross pollution of a shallow tidal harbour backwater by liquid waste products from industries and by urban sewage effluents created conditions which resulted in the generation of sufficiently large amounts of hydrogen sulphide to create a major air pollution problem. Hydrogen sulphide was present in the air throughout the year near its source, but on very many occasions during the hours of darkness and early morning, particularly in the late summer and autumn, its presence caused widespread complaint of offensive odour and paint blackening even at considerable distances from its source. The hydrogen sulphide was cound to be derived from bacterial reduction of sulphate in the sea water. The pollution of the inlet ceased in May 1961 and in the following four months considerable evidence was collected which showed a substantial drop in hydrogen sulphide being evolved from the inlet and its almost complete absence in the surrounding atmosphere. The abrupt change in the hydrogen sulphide levels in attributed to the removal of abundant and readily available bacterial nutrients, and the reappearance of normal levels of dissolved oxygen in the water. (Author abstract)

05614

J. L. Mills, R. T. Walsh, K. D. Luedtke, and L. K. Smith

QUANTITATIVE ODOR MEASUREMENT. J. Air Pollution Control Assoc. 13 (10), 467-75, Oct. 1963. (Presented at the 56th Annual Meeting, Air Pollution Control Association, Detroit, Mich., June 9-13, 1963.)

The most satisfactory device available for quantitative odor measurement is the human olfactory system. It is much more sensitive than chemical measurements in most cases where odors are nuisance problems, and results are obtained where chemical tests fail. Threshold response odor measurements produce quantitative results more quickly than other types of tests. The definition of the odor concentration as 'the dilution factor at the odor perception threshold for 50% of the odor panel' is believed to be a more reproducible standard than that described in the ASTM method. The odor unit should be redefined from 'one cubic foot of air at the odor threshold' to 'the quantity of any odorous substance or of any given mixture of odorous substances which, when completely dispersed in one cubic foot of odor-free air, produces a median threshold odor detection response in humans.' The modifications to the ASTM odor measurement method described herein are believed to improve the speed, reliabiligy, and reproducibility of the method. Careful application of this method and the use of good laboratory techniques should produce results considerably more reproducible than plus or minus 50%. The application of the threshold response method of quantitative odor measurement is highly successful in determining the actual effectiveness of odor control measures and devices. Control of odors from the 'offensive trades' can be achieved by proper incineration for 0.3 sec at 1200 F, but certain of the objectionable organic chemical industry odors require higher temperatures of incineration before adequate odor control is accomplished. Chlorination followed by intensive scrubbing has been found satisfactory under controlled conditions for the off-gases from a direct-fired, rotary fish meal drier. Odor nuisances from animal matter reduction equipment used in the 'offensive trades' can be prevented by reducing the odor concentrations in the off-gases to a point where the average is not more than 25 to 50 odor units/cu ft and the absolute upper limit is 150 odor units/cu ft.

05813

Turk, A.

ANALYTICAL AND ODOR STUDIES OF ORGANIC GASES IN AIR. (FINAL REPORT). Preprint, 1966.

Part I. Use of SF6 as a gas-air tracer. SF6 was used for tracer research because it satisfied all of the following requirements, except for negligible background level: (1) non-toxic, non-radioactive, colorless and odorless; (2) gaseous at ambient temperatures; (3) low background levels; (4) chemically and thermally stable; (5) amenable to rapid and controlled atmospheric release from a point source; (6) amenable to routine collection; (7) amenable to sensitive, rapid analytical detection (electron capture detection). Part II. Preliminary comparison between the atmospheric dispersion of fluorescent pigment (FP) and SF6. Sampling results indicated a great deal of variation between the two tracers as shown by the low correlation coefficient of 0.62. Centerline comparisons indicated that the attenuation of FP by fallout or impingement might be significant. Part III. Studies of brominated carbon. These included the following: (1) Bromination procedures; (2) Preparation of : 2 orthobromophenyl-2-propanol; ortho-bromocumene; meta-bromocumene; proof of surface reactions in olefin brominations; olefin brominations; aromatic hydrocarbon brominations. Part IV. Miscellaneous studies. These included (1) Applications of tracer methods to odor study; (2) Applications of tracer methods to study of adsorption efficiency of activated carbon beds. SF6 is not satisfactory because it is not sufficiently well retained in carbon. A more satisfactory test gas for this purpose is CC14.

05898

A. H. Phelps, Jr. J. F. Byrd

ODOR AND THE SOCIALLY ACCEPTABLE INDUSTRY. A. I. Ch. E. (American Inst. of Chemical Engineers) Preprint. (Presented at the Symposium on Industrial Air Pollution Control, 59th Annual Meeting, American Inst. of Chemical Engineers, Detroit, Mich., Dec. 4-8, 1966, Paper No. 51 E.)

The major problem facing an engineer in controlling odor is in quantifying the problem. For most specific compounds, an analytical method is available for establishing the concentration of the material in a source or even in the lower concentrations in the ambient situation. There is no device capable of registering the presence of an odor and its strength. The nose has many other desirable features which make it useful for measuring odor. The simplest is the ASTM method, where a syringe is used to inject a sample into the nostril and the judgment is made aa to whether or not an odor is present. The syringe is filled with varying dilutions for each test and the measure of the odor strength is the number of dilutions necessary to dilute the sample to threshold. Other methods are used for making the odor judgment: a face mask may be used, or the head may be immersed in a hood and bathed in a concentration. But basically they all measure the number of dilutions necessary to reduce the odor sample to a level below threshold. The odor unit is used as the unit of measure. One odor unit is defined as that quantity of odor necessary to contaminate one cubic foot of air to the threshold or barely perceptible level. This measure is simply one of concentration, and while this is a valid measure of the odor strength in the ambient air it is not usable for a source. The concentration in a source is not as important as the quantity emitted. We need to know how many 'pounds per hour' of odor units per minute. This is obtained simply by the product of the stack flow and the odor concentration or number of odor units in the stack. For example, our exhaust with 100 odor units per cubic foot, obtained from the intensity measure, times the flow volume - say 1000 cfm - gives an odor emission of 100,000 odor units per minute. This number can be used in the standard atmospheric diffusion formulae to determine the ground level concentration in the neighborhood. And from this, the degree of control required to prevent a problem can be estimated. Besides human panels there are other methods of measuring the threshold level of odor. However, the advantage to this method is that the syringes are inexpensive and an odor test can be run for a minimum of expense. The main problem for the chemical engineer in this field is not design of odor control equipment. It is the problem of recognizing the odor potential in the pilot work preceding the actual facility. An alert nose, and an occasional thought toward sampling can provide for control equipment in the

06112

Tada, O.

MEASUREMENT OF AIR POLLUTANTS. Bunseki Kagaku (Japan Analyst) (Tokyo) pp. 110R-7R. 1966. Jap.

Important papers published in Japan Analyst in 1964 and 1965 are summarized. The subject is limited to measurement methods of air pollutants known to be toxic to health. Pollutants from stacks and automobile exhausts are covered, including many cyclic hydrocarbons, aldehydes, sulfur oxides, nitrogen oxides, ozone, carbon monoxide, carbon dioxide, fluorine compounds, hydrogen sulfide, lead compounds, and offensive odors. Various sampling methods are described, especially using filtering with glass wool filters, electric dust collectors, gas absorbers, and portable samplers containing silica gel. The pollutants can be measured by electroconductivity

methods, colorimetric measurement recorder, gas chromatographic analysis, electron capturing detector, and hydrogen ion detector. The papers summarized do not include those dealing with industrial or occupational environment or mining.

06381

Duffee, R. A.

APPRAISAL OF ODOR-MEASUREMENT TECHNIQUES. J. Air Pollution Control Assoc., 18(7):472-474, July 1968. 13 refs.

All odor measurement methods may be conveniently grouped into three categories: (1) threshold; (2) suprathreshold; and (3) analytical. The threshold techniques include such methods as syringe dilution, scentometer, and osmoscope. Suprathreshold techniques include both direct comparison and dilution methods involving subjective ratings of preference as opposed to intensity. Analytical techniques involve the use of physicochemical methods, e.g., for monitoring of process streams or identification of individual odorants. The relative advantages and disadvantages of each method, as presently used, are discussed. Recommended applications for the various methods and suggested modifications are also presented. (Author's abstract)

06526

D. F. Adams

GAS CHROMATOGRAPHY APPLIED TO ATMOSPHERIC KRAFT ODORS (FINAL REPT. MAY 1, 1963 - APR. 30, 1966). Preprint. 1966.

The objective was to analyze qualitatively the malodorous, kraft pulp mill air pollutants in the ambient air by the gas-liquid chromatographic technique, including the use of ionization detection and Golay columns. Gas chromatographic detectors, available in 1963, were evaluated for sulfur-gas sensitivity and specificity. Coulometric detectors gave the best overall sensitivity and specificity. Therefore, the research was continued, using the coulometric detection principle. A sulfur-specific, bromine coulometric detector, having a sensitivity approaching the human sensory threshold, has been developed as a result of this research. This cell is a significant improvement over the previously available iodine coulometric detector. Two circuit improvements were made in the coulometer which permitted greater reproducibility and control of the critical detector bias voltage. Losses of sulfur-containing compounds on the gas chromatographic columns studies were found to be so large that direct GLC analysis of ambient air was impossible. The magnitude of these losses have been established. Using currently available GLC columns and detectors, a successful technique for analysis of sulfur compounds in the ambient air will have to rely upon pre-concentration of these compounds by either adsorption or freeze out.

07214

Bethge, Per Olof and Lalla Ehrenborg

IDENTIFICATION OF VOLATILE COMPOUNDS IN KRAFT MILL EMISSIONS. Svensk Papperstid. (Stockholm), 70(10):347-350, May 31, 1967. 3 refs.

Identification of compounds contributing to the odour from kraft mills was accomplished by gas chromatography, and in some cases in combination with mass spectrometry. Attention was centered on the most volatile compounds. Besides seven terpenes, 25 compounds were identified.

07266L

Reckner, L. R.

FINAL REPORT ON DIESEL EXHAUST: COMPOSITION, ODOR AND EYE IRRITATION. FOR PERIOD DECEMBER 3, 1965 TO DECEMBER 2, 1966. (Scott Research Lab., Inc.) Contract PH 86-66-91, Project 1054, ((52))p., June 12, 1967.

Improved techniques were developed for measuring diesel exhaust odor using a human panel. An odor profile kit of diesel odor standards were liquids contained in 32 polyethylene bottles. The head gas expelled by squeezing the bottles served as the reference odors. A correlation program was run to determine possible correlation between panel ratings and chemical analyses. Analyses of variance were also made to relate the sensory and chemical data to the operating variables which included two speeds, four loads, two fuels, and two dilutions. Changing the exhaust dilution ratio had the greatest effect on panel response. The results indicate that a human panel trained to use odor standards shows excellent promise toward providing a means of measuring the intensity of diesel exhaust odor. Considerable effort was expended toward identification of compounds contributing to diesel exhaust odor. Attention was focused on extracts exhibiting odor qualities which could be identified in exhaust. Revisions in the collection method to trap the odorants as stable derivatives or complexes were studied. Some preliminary odor evaluations and chemical analyses were made on exhaust from the newly-installed precombustion-chamber-type engine. The limited observations made indicated that the exhaust odor intensity from this engine was considerably less, and the concentrations of unburned and partially burned hydrocarbons were slightly to substantially lower than those from the direct injection engines tested previously.

08066

Wohlers, Henry C.

RECOMMENDED PROCEDURES FOR MEASURING ODOROUS CONTAMINANTS IN THE FIELD. J. Air Pollution Control Assoc., 17(9):609-613, Sept. 1967 15 refs.

Although the perception of odorous contaminants cannot be precisely described, certain basic facts about human olfaction are known. With known facts or principles, it is possible to investigate odorous contaminants for air pollution control purposes. Odor remains, however, a very intangible commodity. Odorous contaminant investigations must be tailored to the individual problem or locality. Consequently, the methods described were designed for individuals who have working knowledge of either odor or air pollution problems. Background references are available for workers who are not familiar with either field. Generalized facts concerning odors as well as subjective and objective methods for measuring odorous contaminants in the field are described. The use of specific portions of the method depends upon each individual investigation. (Author0s summary, modified)

08268

Adams, Donald F., Francis A. Young, and R. A. Luhr

EVALUATION OF AN ODOR PERCEPTION THRESHOLD TEST FACILITY. TAPPI, 51(3):62A-67A, MARCH 1968. 4 refs. (Presented at the 52nd Annual Meeting of the Technical Association of the Pulp and Paper Inductry, New York, N. Y., Feb. 19-23, 1967.)

The design of a facility for the study of odor perception and objectionability thresholds within a large human population is described. A dynamic system of odor generation was used to provide a series of test atmospheres in the parts per billion concentration range within six exposure chambers. Panelists were consecutively exposed to the six identical test chambers, each containing a different concentration of the same compound or purified air. Test atmospheres were presented in ascending, descending, or random order and ranged from undetectable to objectionable for most panelists. The panelists reported, for each chamber, whether or not an odor was detected and, if an odor was detected, whether it iwas pleasant or unpleasant. In addition, each panelist provided comprehensive personal information including age grouping, sex, smoking habits, respiratory abnormalities, occupation, and population range of residence. The variability of individual response was evaluated for eleven trained panelists through repeated exposure to four compounds presented in ascending, descending, and random sequences over a period of several days. The normal variation in threshold for each individual and the entire test panel are discussed. These data form a statistical basis for examination of the response of nearly 6000 untrained subjects who were exposed only once to five concentrations of a single compound in the six chambers. (Authors' abstract)

08354

Brink, D. L., and J. F. Thomas, and D. L. Feuerstein

MALODOROUS PRODUCTS FROM THE COMBUSTION OF KRAFT BLACK LIQUOR. II. ANALYTICAL ASPECTS. TAPPI, 50(6):276-285, June 1967. 25 refs. (Presented at the 51st Annual Meeting of the Technical Association of the Pulp and Paper Industry, New York, N. Y., Feb. 21-24, 1966.)

Gaseous and liquid products isolated by pyrolysis of kraft black liquor, were analyzed qualitatively and quantitatively using gas-liquid chromatography with detection by flame ionization. More than 60 compounds were detected in the pyrolysis liquid and at least 32 of these were present in the pyrolysis gas. Using the microcoulometric titration system, hydrogen sulfide, methyl mercaptan, dimethyl sulfide, dimethyl disulfide, and at least 19 unidentified sulfur-containing components were detected in the pyrolysis products; 7 of the major components were determined quantitatively. Using cochromatography and the methods of detection noted, the identities of methyl mercaptan, dimethyl sulfide, and dimethyl disulfide were verified and tentative identifications of several other sulfur-containing products were also made. Hydrogen, oxygen, nitrogen, methane, carbon monoxide, ethane, carbon dioxide, and acetylene were resolved and determined quantitatively. Hydrogen sulfide, methyl mercaptan, and five unidentified components were also qualitatively detected. Sulfur present in pyrolysis residues was determined using a wet oxidation procedure. A powerful analytical method has been developed for detailed study of the effects of recovery furnace operation on such emissions and it should prove to be a valuable aid to industry. With adequate development, pyrolysis carried out independently of gaseous, liquid, and solid products could provide an answer to complete odor control; in addition, isolation of organic by-products may be feasible. AAM

08355

Cave, G. C. B.

THE COLLECTION AND ANALYSIS OF ODOROUS GASES FROM KRAFT PULP MILLS. PART I: THEORETICAL CONSIDERATIONS. TAPPI, 46(1):1-5, Jan. 1963. 4 refs.

A new method is proposed for the simultaneous collection of all pollutants from gaseous kraft-mill effluents and process streams. The pollutants are in part frozen out in an empty cold trap, and in part dissolved in traps containing ethylbenzene as a solvent at about minus 78 C. Formulas are derived that provide quantitative information on the performance of these traps toward pollutants having a wide range of boiling points. These formulas give the concentration of a pollutant in the solvent, as a function of the sample volume; the sampling time; the percentage of a pollutant retained by a trap from a polluted airstream; and the instantaneous concentration of a pollutant in the exhaust air from a trap. The formulas are not limited to kraft-mill pollutants. The special case of a poorly absorbed pollutant is treated, and a sampling program for this case is prescribed. The distribution ratios of methyl mercaptan, hydrogen sulfide, and sulfur dioxide between an airstream and a solvent are calculated, and for the first two, values are also found by experiment. (Author's abstract)

08356

Cave, G. C. B.

THE COLLECTION AND ANALYSIS OF ODOROUS GASES FROM KRAFT PULP MILLS. PART II: A LABORATORY STUDY OF THE COLLECTION OF POLLUTANTS FOR ANALYSIS. TAPPI, 46(1):5-11, Jan. 1963. 5 refs.

An experimental study was made of the performance of traps, in collecting kraft-mill pollutants from an air stream. The traps were in a mixture of dry-ice and acetone. Some traps in the train were empty; others contained ethylbenzene as a solvent. A convenient experimental method is described for artificially producing a polluted air stream, and for evaluating the performances of traps. The distribution was found of hydrogen sulfide, sulfur dioxide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide among the traps of the train. The effect of flow-rate, volume of solvent, and trap design on trap performance was measured. The effect of varying the degree of air turbulence in an empty cold trap was studied. It was confirmed that cold ethylbenzene is a satisfactory solvent for all the pollutants except hydrogen sulfide. For this latter pollutant, an aqueous solution of cadmium was used to trap it. A study was included on the losses of the pollutants that might occur on extended storage of their ethylbenzene solutions. Apparatus and a procedure are described for the concentration of the original ethylbenzene solution of pollutants, to improve the sensitivity of the method. (Author's abstract)

08357

Cave, G. C. B.

THE COLLECTION AND ANALYSIS OF ODOROUS GASES FROM KRAFT PULP MILLS. PART III: THE ANALYSIS OF COLLECTED POLLUTANTS BY GAS CHROMATOGRAPHY. TAPPI, 46(1):11-14, Jan. 1963. 4 refs.

The qualitative and quantitative analysis of kraft-mill pollutants in ethylbenzene by using gas chromatography is discussed. Columns of tri-m-cresyl phosphate and of Carbowax 1540 are proposed for use at 35 and 85 C. These columns permit the resolution of all known kraft-mill pollutants. Techniques are described for qualitative analysis. They include the two-column method, and graphs prepared by this method are presented for homologous series of mercaptans, ketones, esters, and normal alcohols. It is emphasized that the unequivocal identification of an unknown pollutant is rarely possible by gas chromatography alone. Quantitative analysis is also described, including the preparation of standard solutions and the presentation of prepared calibration curves. These curves were straight lines. The use of an ultrasensitive detector, the ionization chamber, is briefly discussed. (Author's abstract)

08358

Cave, G. C. B.

THE COLLECTION AND ANALYSIS OF ODOROUS GASES FROM KRAFT PULP MILLS. PART IV: A FIELD KIT FOR THE COLLECTION OF THE POLLUTANTS, AND METHODS FOR THEIR ANALYSIS. TAPPI, 46(1):15-20, Jan. 1963.

A complete field kit is described and illustrated. A train of traps mounted in a portable carrying case includes an empty trap at 0 deg C. to collect mlisture, an empty trap at minus 78 C. to collect high boiling pollutants, two traps containing ethylbenzene at minus 78 C. to collect pollutants other than hydrogen sulfide. and a trap containing cadmium solution for H2S. Heated glass sampling tubes convey the effluent sample to the traps. Pollutants that are quantitatively and simultaneously collected include hydrogen sulfide, sulfur dioxide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. For hydrogen sulfide, an iodimetric determination is described to be made at the mill. For the other pollutants, gas chromatographic analyses are described which may be made at a later, more convenient time. (Author's abstract)

08678

Huey, Norman A., Louise C. Broering, George A. Jutze, and Charles W. Bruger

OBJECTIVE ODOR POLLUTION CONTROL INVESTIGATIONS. J. Air Pollution Control Assoc., 10(6):441-446, Dec. 1960. 4 refs. (Presented at the 53rd Annual Meeting, Air Pollution Control Assoc., Cincinnati, Ohio, May 22-26, 1960.)

The objective of any odor investigation is to obtain elimination or correction of the source. More objective odor complaint investigative procedures must be developed. The specific odor characteristics of concern in these procedures are; quality, strength, and occurrence of the ambient odors. These are discussed. The scentometer has been designed to aid in more objective procedures. A detailed description is given of this organoleptic instrument. The accuracy and precision of results depend upon the human olfactory sense. Variations in the olfactory ability were observed in a human panel. A standard procedure is described for ambient odor investigation. A method used to determine wind direction in the odorous area, using helium inflacted balloons is presented. Also presented are results of a study of the meteorological effects on odor nuisance occurrences.

08953

Lindvall, Thomas

MEASUREMENT OF ODOROUS AIR POLLUTANTS. (Bestamning av luktande luftfororeningar.) Text in Swedish. Nord Hyg. Tidskr. (Copenhagen), 47(2):41-71, 1966. 91 refs.

Psychometric methods for the sujective determination of odorous air pollutants are surveyed, with a discussion of the physiological and psychological bases of smell. Since odors are a a problem of emvironmental hygiene, they are studied at present by the determination of an odor threshold in a series of diluted air samples. Some of the problems involved in such determination of an odor threshold in a series of diluted air samples. Some of the problems involved in such determinations are mentioned: individual variation, adaptation, background variables, climate etc. Psychometric methods used, such as stimulus presintation and indicator response, and the pricciples of extrapolationg supralim- inal intensities, are discussed, as well as the different types of olfactometers. Odor thresholds found in the literature are rarely similar, due to the inaccuracy of the physical and chemical analytic methods used and to the varying statistical and sampling techniques employed. Different odors may also interact so that the threshold to the combined smells may not be merely additive. Annoyance from odors is best studied by epidemiological methods where the exposure dose is known.

09364

Hemeon, Wesley C. L.

TECHNIQUE AND APPARATUS FOR QUANTITATIVE MEASUREMENT OF ODOR EMISSIONS. J. Air Pollution Control Assoc., 18(3):166-170, March 1968. 5 refs.

A system and apparatus is described for a measurement of rates of odor emission from sources. Discussion deals only with odor quantities, not with odor quality. A dynamic dilution system is employed to avoid reliance on yes-no reports near the odor threshold where greatest confusion and uncertainty occurs and which requires a relatively large number of subjects and statistical treatment of the sensation data derived therefrom. The procedural aspect of the present system requires each test to develop a series of odor intensity votes from exposure to a sequence of streams of increasing strength. Graphical analysis of these data validates quantitatively the sensation of each individual subject separately and with a minimum of uncertainty. The apparatus is of liberal dimensions to minimize loss of odor by adsorption on the walls of the sampling device or of the dilution mechanism. i.e., the odor meter. The device also is designed to supply a liberal flow of the test stream to each subject and to provide numerous such exposures in rapid sequence. (Author's Summary)

09476

P. M. Giever

NEEDS FOR REMOTE SENSING DATA IN THE FIELD OF AIR AND WATER POLLUTION CONTROL. In: Proceedings of the Fourth Symposium on Remote Sensing of Environment, 12, 13, 14 April 1966, Michigan Univ. Ann Arbor, Willow Run Labs., Contract NRnr 1244(44), 4864-11-X, p. 21-23, June 1966. CFSTI, DDC; AD 638919

One of the greatest needs is for instrumentation that will accurately evaluate the several oxidants, such as NO, NO2, NO3, and O3 in the range od parts per hundred million. These devices are needed for evaluation of stack gases, and for the ambient atmosphere. Nondispersing infrared has been used for many years for evaluating carbon monoxide but interference from water vapor has not been satisfactorily controlled. The use of infrared with complete accuracy in evaluating CO would be very helpful and the hydrogen sulphide generation in sewage sludge digesters and remote sensing instrument would be very useful as sentinals or its removal from digester gas. (Authors' summary) alarms. Remote sensing of SO2 with the data fed into a central point would be helpful. Accurate identification and quantifica- tion of polynuclear aromatic hydrocarbons in general atmosphere without sampling and laboratory analysis is needed. Evaluating automobile exhaust in the atmosphere, separating the constituents of interest and analyzing each quantitatively would be a major aid to this area of air pollution control. Sensing devices to evalu- ate odors would be particularly helpful. There is a need for means of determining the effective stack height, levels of in- version layer, and of remote temperature sensing. Instrumentation is needed for accurately determining the moisture content of stack gases, new and accurate equipment is needed for the evalua- tion of rate of flow of effluent in a discharge stack. Determina- tion of solids in a stack and in the general atmosphere by direct reading devices would be a major contribution. Instrumentation which will give accurate reproducible results in the sizing or counting of the entire spectrum of size (and shapes) of solid particulate is needed. New instruments and techniques to provide fast, accurate analysis for fluorine, lead, hydrocarbons and many others, each having long periods of extraction or reaction and many intermediate steps are also needed.

09521

Dravnieks, A., and B. K. Krotozynski

COLLECTION AND PROCESSING OF AIRBORNE CHEMICAL INFORMATION, II. J. Gas Chromatog., 6(3):144-149, March 1968. 6 refs.

A previously described method for collection of airborne chemical information through equilibration and processing of the samples is considerably improved. The essential new features are a sampler in the form of a fluidized bed of Teflon powder coated with Apiezon L stationary phase, a redesigned collector-injector, and a motor - operated bellows apparatus for injecting samples into the column by use of a carrier gas-derived helium charge. A calibration method is decribed that permits relating the concentration of known substance in air to its peak area. The capability of the new method permits analysis of airborne organic vapors at concentrations of the order of 1 ppb in air and well below the odor thresholds for the several substances tested. The concept of Tanimoto distance is proposed as a convenient, simple construct for characterizing the overall similarities of olfactronic signatures of complex sources.

09619

Adams, Donald F.

ANALYSIS OF MALODOROUS SULFUR-CONTAINING GASES. Preprint, Wash- ington State Univ., Pullman, Research Div., 18p. 1968. 41 refs (Presented at the 9th Conference on Methods in Air Pollution and Industrial Hygiene Studies, Pasadena, Calif., Feb. 7-9, 1968.)

Five major sulfur containing gases which are known products of combustion,decomposition or organic matter, and certain chemical manufacturing processes have been selectively separated by use of a series of chemically-impregnated membrane filters. A sequential, substractive,stepwise analysis has been accomplished with a bromine coulometric micro-titration cell and is here described. The sensi- tivity of this system approaches the threshold of human detection for these compounds. Several methods and instruments used in the sampling and measuring of these gases are reviewed. The gases discussed here include hydrogen sulfide,methyl mercaptan, sulfur dioxide dimethyl sulfide, and dimethyl disulfide.

09620

Dravnieks, A., B. Krotoszynski, and J. Stockham

SAMPLING AND MEASUREMNT OF ODOROUS GASEOUS POLLUTANTS IN INDUST- RIAL EXHAUST AND AIR. Preprint, IIT Research Inst., Chica- go, Ill., ((12))p., 1968. 4 refs. (Presented at the 9th Con- ference on Methods in Air Pollution and Industrial Hygiene Studies, Pasadena, Calif. Feb. 7-9, 1968.)

In studies of odorous sources of air pollution, several samples of air must be compared for odor intensity, odor threshold, and odor quality. Furthermore, to improve odor control at its source or to judge the relative contribution of several sources to air pollution components present in the 0.1 ppb range and to establish the rela- tive relevance of each component to the characteristic odor of the air sample or industrial or vehicular exhaust. Sampling collect- ion on Apiezon L-coated Teflon particles, kept in motion during sampling, gives an equilibrium mode of air-composition representa- it is sometimes necessary to determine the concentration of organic tion. Consequently, such samples can be used for odor comparisons as well as for objective analyses. Odor-intensity scales, odor- dilution thresholds, and triangle odor-quality-difference tests using the 'sensory titration' technique are used for odor charact- erization. Each of these tests requires a different type of ol- factometer. Gas-chromatographic analysis of samples obtained by the equilibrium mode method, coupled with odor/no-odor judgment of the components emerging from the analytical column, permits the re- lative odor relevance of various odorants to the odor of the whole air sample to be established. (Authors' abstract)

09648

Cederlof, Rune, Lars Friberg, and Thomas Lindvall

THE ORGANOLEPTIC EVALUATION OF ODORS WITH SPECIAL REFERENCE TO THE KRAFT PULP INDUSTRY. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and University of Florida, DeLand, Fla., E. O. Painter Printing Co., ((1966)), p. 111-140. 16 refs.

The quantitative determination of malodorous air pollutants in ambient air is complicated by the fact that their smell becomes offensive at concentrations which are too weak for the practical analysis of shortterm measurements. Organoleptic methods have therefore been resorted to. It is of concern to be able to calculate the size and extent of an emission of odors. This is difficult because of the lack of knowledge of the identity of chemical substances in the effluent, and of the relationship between interactions of the compounds and strength of the smell. One approach is to determine the smell, either of emissions in the ambient air or of flue gases at the top of the stack in conjunction with calculations of meteorological dispersions. This would give a measure of the relevant, total exposure to odors at ground level at different distances from the source. Another method is to study the occurrence of odors in ambient air around a factory with the aid of observers. The chemical substances generally held to be responsible for the odors in the effluent are: hydrogen sulfide, methyl mercaptan, dimethyl monosulfide and dimethyl disulfide. Applications of the first approach are described presenting results of smell of some of sulfur compounds and, field studies of the flue gases from two sulfate cellulose plants in Sweden. The determination of odor threshold, as a solution to the problem, has certain obvious advantages, while studies with observations are also of value. What is wanted is a comparative study to discover the extent to which results from these two approaches agree. A lengthy discussion by one of the authors and others is appended.

09657

Hasselhuhn, B.

SAMPLING AND ANALYTICAL PROCEDURES USED IN CONNECTION WITH THE SWEDISH ODOR STUDIES. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and University of Florida. DeLand, Fla., E. O. Painter Printing Co., ((1966)). p. 349-353.

The sampling methods and analytical procedures used in previous odor threshold studies for SO2, H2S, CH3SH, (CH3)2S, and (CH3)2S2 are described. The instability of some reagents is also dealt with.

09660

Walter Lenz, and Adalberto Tirado A.

METHOD OF MEASURING ODORS BY MEANS OF OBSERVERS. In: Pro- ceedings of the International Conference on Atmospheric Emis- sions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and Univer- sity of Florida. DeLand, Fla., E. O. Painter Printing Co. ((1966)), p. 365-369.

A simple method used to determine the effectiveness of the control of malodors from a kraft mill is described. A specific number of persons are asked to make a weekly report on the conditions of odor prevailing at their homes. The observers are located at different distances within a defined radius. The form delivered to the ob- server is arranged so that daily complaints can be reported for strong and slight odor, and for no odor. The form is sent to the mill where evaluation starts by completing the report with data of conditions prevailing in the mill at the time shown by the obser- ver. Next it is determined whether complaints are due to the kind of wood being cooked, to stack gases, or to improper blowing and relieving conditions. It is also decided whether or not the par- ticular complaint is justified and finally, the probable cause of the complaint is recorded. Criteria employed in the evaluation procedure are listed. The total number of weekly complaints is divided by the total number of blosw. The result is a relative index which measures the odor level. Finally the annual average of weekly relative indexes is obtained.

09716

Just, Jan

ON MEASUREMENT OF 'PERMISSIBLE CONCENTRATION OF EXHAUSTS' EMITTED TO ATMOSPHERE. ((W sprawie pomiaru 'dopuszczalnych stezen wyziewow' wydalanych do atmosfery.)) Text in Polish. Gaz, Woda Tech. Sanit. (Warsaw), 41(5):162-163, May 1967. 3 refs.

The measurement of objectionable odors is discussed with reference to the Sept. 1966 Decree of the Council of Ministers on the degree of permissible concentration of emitted substances in the atmosphere. The human sense of smell is the only practical way of measuring such odors, as exemplified by the classification of odors and identification methods used in America, such as the use of observer corps or firefighter brigades. The use of an odorimeter (made in USA) which is illustrated, is suggested for determining the permissible concentration of odors. Using a 0-5 scale, the tolerance limit is proposed at 2 for odors of burning fumes, at 1 for chemical-pharmaceutical smells, and at 1 for putrid odors on the lee side of the wind.

09860

APPENDIX B: ODOR-TEXTING TECHNIQUES. In: Air Pollution Engineering Manual. (Air Pollution Control District, County of Los Angeles.) John A. Danielson (comp and ed.), Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, PHS- Pub-999-AP-40, p. 861-864, 1967. GPO: 806-614-30

The use of an odor panel for the evaluation of odor is commonly employed. A panel has 6-8 subjects so that average results can be obtained. Techniques of odor sample dilution and odor sampling are discussed. A method of analyzing the experimental results is demonstrated with typical test data.

10016

Dravnieks, A. and B. K. Krotoszynski

COLLECTION AND PROCESSING OF AIRBORNE CHEMICAL INFORMATION. J. Gas Chromatog., 4(10):367-370, Oct. 1966. 9 refs.

A novel method is advanced for collection and processing of airborne chemical information. The method is based on the concept collection through equilibration and utilizes thin films of stationary organic phases residing on inner surfaces of spiral Pyre traps. A special collector-ejector system is used for transfer of vapors from traps into a chromatograph for analysis. An illustrati is given of a typical human olfactronic signature obtained by the method. (Author's abstract)

10029

National Swedish Inst. for Building Research, Stockholm, Sweden

AN ATTEMPT TO MEASURE OBJECTIVELY THE QUALITY OF AIR. Report 34/67, 42p., 1967. CFSTI: PB 177763

The results of the tests of validity, precision, reliability and correlation indicate that gas chromatographic analysis can be used for the objective measurement of air quality. It records not only great differences of quality between malodorous air and fresh air, but also provides a criterion for the air pollution which takes pla during a lecture hour in an insufficiently ventilated assembly room The objective measurement is in the form of a non-dimensional quantity which designates the relation between the surfaces under a spectra for polluted and for fresh air. The correlation to subjective judgement has been made by a simple estimate of the air quality. This includes an uncertainty, because the test subject cannot make comparisons in pairs with clearly defined reference samples and different dilution of the sample air. This means that the quality could only be divided into the three very rough categories: fresh, stale and very bad air. In order to ensure that the method of measurement of the air quality proposed here is relevant, it is certainly necessary for more work to be done. Firs of all, a better statistical basis must be found, by carrying out a large number of air tests in many different places of assembly with different kinds of ventilation, such as schoolrooms. (Author's summary, modified)

10534

Trieff, Norman ., Theodore C. Erdman, Stevens N. Field, Lester Kershenbaum

ANALYSIS OF INDUSTRIAL ODOR EMISSIONS. Preprint, Drexel Inst. of Technology, Philadelphia, Pa., Environmental Engineering and Science Program, ((39))p., 1968. 24 refs. (Presented at the 19th Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, Inc., Cleveland, Ohio, March 7, 1968.)

This investigation is primarily concerned with techniques for sampling and analysis of industrial odors. While the scope of the research is limited to a study of rendering plant emissions so as to permit investigation in depth, it will be clear that the techniques developed are applicable to other industrial emissions. The problem in the analysis of odors are numberous. The first significant one is that the odor-causing components are generally present in very low concentrations, i.e., in the parts per billion (ppb) range. The second problem of importance is the complexity of most odors. Some of the odor components are highly reactive, susceptible to oxidation or decomposition, for example, and thus, in the sampling and analysis procedure, the original components are destroyed. The theory of odor perception is still quite primitive. There is no clear-cut way of measuring any one or several physical or chemical properties of a molecule and predicting the odor. An even more involved problem is the prediction of the qualities and respective intensities of a complex odorous mixture. One cannot look at a gas chromatogram of a complex mixture and determine from the respective retention times and areas of the peaks on various columns which are the odorous substances, what are the qualities of these odors, and what are the respective intensities. It is necessary in this case to have enough of each component present to sniff the effluent. Fortunately, this is not usually too difficult a task.

10593

Dravnieks, A. and B. K. Krotoszynski

COLLECTION AND PROCESSING OF AIRBORNE CHEMICAL INFORMATION. J. Gas Chromatog., 4(10):367-370, Oct. 1966. 9 refs.

A novel method is advanced for collection and processing of airborne chemical information. The method is based on the concept of collection through equilbration and utilizes thin films of stationary organic phases residing on inner surfaces of spiral Pyrex traps. A special collector-ejector system is used for transfer of vapors from traps into a chromatograph for analysis. An illustration is given of a typical human olfactronic signature obtained by the method. (Authors' abstract)

10693

Krotoszynski, B. K., and A. Dravnieks

ODOR-RELEVANT MEASUREMENT OF ODOROUS POLLUTANTS IN AIR. Preprint, IIT Research Inst., Chicago, Ill., 17p., 1968. 6 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968, Paper 68-17.)

Frequently it is difficult to determine, by direct odor observation, which of the possible odor sources contributes most to the odor. If the source is ascertained, it is difficult to estimate what reduction in odor emission will be needed to reduce odor to subthreshold values. These tasks are facilitated by an analysis of air for odorants characteristic of the sources in the environment and by comparison of the concentrations of these odorants in air with their threshold concentrations. Recently (1,2) a new technique, denoted equilibration sampling, has been developed for measurement of ppb concentrations of organic vapors in air. The air sampler (Figure 1) consists of a glass cylinder equipped with two stainless steel screens between which Teflon powder, coated with Apiezon L. film, can be maintained in floating state by air sample rapidly pulled by means of a battery-powered air fan through the sampler. Vapors dissolve in the film until an equilibrum is reached. The collected vapors are transferred to a gas chromatograph and analyzed. The described air sampling technique can be easily adapted to calibration in terms of odor thresholds without an intermediate need for calibration by weight or concentration.

10983

Matsushita, Hidetsuru,$ H. Arito, Y. Suzuki, R. Soda

DETERMINATION OF THRESHOLD VALUES FOR OLFACTORY PERCEPTION OF PRIMARY ODOUR SUBSTANCES. Ind. Health, 5(3-4):221-237, Dec. 1967.

Population threshold for olfactory perception have been obtained with eight kinds of primary odor substances to develop the method of field study. Triangle method and serial method have been used for the measurement and the latter has been proved to be suitable for the present purpose. Reliability of population threshold values for olfactory perception and effect of volume of sample solution on the values have been examined. A new device has been developed to illustrate the olfactory function of subject. (Authors' abstract)

11123

Little (Arthor D.) Inc., Cambridge, Mass.

RESEARCH ON CHEMICAL ODORS. PART I – ODOR THRESHOLDS FOR 53 COMMERCIAL CHEMICALS. Manufacturing Chemists Association, Washington, D.C., 26p., Octo. 1968

The odor thresholds in air of 53 industrial chemicals were determined by panel test. The odor threshold concentrations for th chemicals studied are tabulated in this report as an alphabetical listing and by increasing threshold concentrations. All concentrations are calculated as parts per million by volume. Thes values are reported for 50 percent and 100 percent (two and four members) panel recognition. Based on our experience in odor measurement, it is recommended that the concentrations given for 10 percent recognition should be considered as the recognition threshold values. The spread between 50 percent recognition may be indicative of the individuality of the odor type as well as the constancy of the data obtained. With 27 of the samples examined, 5 percent recognition was equal to the 100 percent recognition concentration, while in 23 instances the 50 percent recognition was once concentration interval lower than the 100 percent recognition.

11167

Sableski, Joseph J.

HOW TO CONDUCT A JOINT COMMUNITY-WIDE ODOR SURVEY. Air Eng., 10(9):16-18, Sept. 1968.

A community wide odor survey often is conducted as part of an air resource management plan to provide background information on air pollution. A guide is presented for setting objectives, selecting observers, evaluating sensitivity, and making odor measurements. Results from a Kansas City survey illustrates the method.

11486

Petrova, M. S. and O. N. Shevkun

HYGIENIC ASSESSMENT OF ODOR OF NONMETALLIC BUILDING MATERIALS. ((K voprosu o gigienicheskoi otsenke nemetallicheskikh stroitel'nykh materialov po ikh zapakhu.)) Hyg. Sanit. (English translation of: Gigiena i Sanit.), 33(4-6):218-220, April-June 1968. ((2)) refs. CFSTI: TT 68-50449/2

Testers were first studied to ensure that they have a normal olfactory threshold (as described below). The testers then evaluated the odor of the building material under test (Vozhzhova and Denisenko). The odor of several coatings and other materials was tested. A varnish coating based on styrene with epoxy ester was tested for its odor 8 months after its application to the substrate. In the testing of a special adhesive with a phenolformaldehyde base, an olfactory sensation was produced by 0.6-0.8 ml air; i.e., it produced a 'moderate odor'. Every material tested by this method (taking into account the specified conditions of its envisaged use) may be categorized in terms of its odor. The method makes it possible to appraise the odor of new articles and materials at moderate cost and with simple equipment.

12359

Moulton, David G.

TELEMETERING OF SPIKE ACTIVITY DURING BEHAVIORAL RESPONSE TO ODORANTS. North Atlantic Treaty Organization, Paris, Proc. NATO Summer School, Theories Odors Odor Measurement, Istanbul, Turkey, 1968, p. 489-491. 6 refs. CFSTI DDC: AD 680057

One approach to understanding neural mechanisms involved in odor detection and discrimination is to examine the spike discharge from the olfactory bulb of an animal. This can be achieved by combining the use of implanted electrodes and telemetering devices with the mass automatic training of rats. An air-dilution olfactometer is described that allows such training. The facility is essentially in two parts: a circular training apparatus and an odor choice tunnel. The first is built around a rotating monodrum which supports two water bottles whose metal nozzles project between its base and the floor of the cage. A current shocking device, connected to each nozzle, can be adjusted to produce a shock sufficient to deter a rat from drinking. Since the drum rotates, the animal cannot select a shock-free nozzle on the basis of its position and is forced to use odor cues. After three nights in the apparatus, training is completed in the odor choice tunnel where odorant and air streams are interchanged. The training technique is similar to that involved in the automatic mass-training apparatus. Olfactory spike activity is telemetered from the olfactory bulb of a trained rat being tested in the odor choice tunnel.

12479

Watanabe, Shinya

THE PROBLEMS OF ODOR NUISANCE. 2. SELECTION OF ESTIMATORS IN SENSORY MEASUREMENT OF ODORS. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):15-17, 1967. Translated from Japanese. 8p.

Despite advances in the chemical analysis of odors, an evaluation of an unpleasant odor in relation to human feelings and sensations must inevitably rely on the human sense of smell. A panel is required for this purpose whose judgement is representative of the local residents concerned. Panel members must have the ability to distinquish a specific odor from another, to detect the existence of a specific component in a mixture, and to differentiate accurately between variations in odor intensity. The size of a panel should be determined according to the purpose and scale of the investigation. Six to ten persons can constitute an effective panel if they are well trained and properly selected. For a large-scale investigation carried out simultaneously at numerous points, a mass panel is appropriate.

12487

Kainosho, Masayasu

THE PROBLEMS OF ODOR NUISANCE. 3. MEASUREMENT AND EVALUATION OF ODOR BY SENSE OF SMELL. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 2(1):no pagination given, 1967. Translated from Japanese. 8p.

Environmental factors influencing functional tests of odor perception are considered. A room used for olfactory tests must be able to absorb sound and must be maintained at approximately 25 C. Next in importance is ventilation: a testing facility of about 10 cu m requires a ventiltion fan with a capacity of 30 cu m/min. The room should be constructed from materials, such as stainless steel or plastic board, that adsorb odors. For a room of 10 cu m, an illumination intensity of 40-60 W is satisfactory. The most commonly used method of evaluating an odor is the five-point system in which an odor is assigned to one of the following categories: no odor, faint odor, tolerable odor, tolerable for a short period of time, intolerable. The tendency of an odor panel to underestimate the strength of an odor must be watched.

12488

Kato, Tatsuo

THE PROBLEMS OF ODOR NUISANCE. 5. SAMPLING AND ANALYTICAL PROCEDURES IN GAS CHROMATOGRAPHIC MEASUREMENT. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1);pagination not given, 1967. Translated from Japanese. 9p.

Gas chromatographic techniques for analyzing odorous components of extremely low concentrations of sample gases are reviewed: the low-temperature absorption and concentration process, and the solid reaction tube process. The first method separates the mixed components of a gas by cooling the gas to a low temperature. To collect atmospheric pollutants, liquid oxygen is used. A disavantage of the method is that the carbon dioxide and moisture in the air are condensed and collected at the same time, and an operation to eliminate them is indispensible. Soda lime is generally used as the removel agent for carbon dioxide and granulated potassium carbonate as the dehydrating agent, a procedure that can lead to the loss of a small amount of pollution components. Though the low-temperature process is suited to the clarification of unknown odors, its operation is complicated. Many reactive components of an odorous air sample are better collected by reaction. In a new technique for collecting reacted materials, air is passed through a glass tube packed with glass beads that are lightly coated with a solid reagent. Because liquid is not used, the total amount of decomposed material can be introduced and analyzed in the gas chromatographic apparatus. Collection efficiency is high. A disadvantage of the method is that it does not permit total analysis of a mixture.

12492

Sawatani, Tsugio

THE PROBLEMS OF ODOR NUISANCE. 4. THE MEASUREMENT OF ODOR. Taik Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1): pagination not given, 1967. 9 refs. Translated from Japanese. 19p.

The measurement of odors is generally divided into separating and estimating the components of a gas sample and measuring the intensity of an odor. There are few occasions when the components of a sample can be determined by gas chromatography, so measurements are usually made with concentrates. Measurements of the intensity of an odor generally depend on the sense of smell. Because there is no way to evaluate the response to an odor on a numerical basis, equipment for measuring odor itensity has not been developed. A specific bond is assumed to exist among the molecules of a substance which has an offensive odor. For example, ammonia, methyl, and amine have a similar smell that is presumably due to the -NH2 group. The idea the flexible vibration of the N-H coupling stimulates the olfactory nerve implies a possible relationship between the propagation and quality of a small and the infrared-absorbing wave-length of its molecule. Problems complicating the measurement of a gas mixture are discussed, and a simple sampling apparatus is described for measuring the odor, of a mixed gas by the salt-solution equilibrium process.

12665

Anon.

ODOR PANEL SMELLS TROUBLE. Mod. Mfg., 1(7):164, Dec. 1968.

The largest cause of public complaints against industrial air pollution in this country is noxious odors. Two methods for testing effectiveness of odor control are the odor panel of sensitive individuals and the Scentometer, an instrument favored by many pollution enforcement agencies.

12942

Wienke, K.

DETERMINING AND TESTING ODOR INTENSITY CURVES OF GASES AND ODORIZING AGENTS. (Ermittlung und Uberprufung der Geruchsintensitatskurven von Gasen und Odoriermitteln). Text in German. Intern. Z. Gaswaerme, 18(6):223-232, June 1969. 3 refs.

The odorizing of almost odorless natural gas is gaining increasing importance with increased use of the fuel on the European continent. Therefore, the development of odor measuring methods gains in urgency. Gaschromatic methods to determine the additive concentrations are expensive because of equipment costs and the need of highly trained personnel. An alternative approach is to measure odors subjectively by means of test persons. Instructions are given on how to perform such tests, and the use of the portable odorimeter and the odor testing chamber is described. The additive concentration for both is varied in steps as follows: 1.0 x 10 to the mth power, 1.8, 3.2, and 5.5 x 10 to the mth power, where m varies between -3 and =2. Ten measurements at each level should be made. The odor is subjectively classified according to five intensity levels. In most cases, a linear relationship between the odor levels and the log of the additive concentration can be expected. For higher precision an S-shaped curve can be fitted. Illustrative examples of graphical plots and numerical data analysis are given, the latter for the regression analysis.

13099

Merkel, J. A., T. E. Hazen, and J. R. Miner

IDENTIFICATION OF GASES IN A CONFINEMENT SWINE BUILDING ATMOSPHERE. Trans. ASAE (Am. Soc. Agr. Engrs.), 12(3):310-313, May-June 1969. 11 refs.

In addition to the already known fixed gases, CO2, CO, H2S, NH3, and CH4, the environment within a confinement swine unit was found to contain a complex mixture of volatile organic intermediates. These intermediates are important in the characteristic odor resulting from the storage of manure and are suspected as being important in animal and building performance. Consideration of physical, as well as organic, biochemical phenomena, indicated that the important intermediate products of anaerobic manure decomposition include organic acids, amines, amides, alcohols, carbonyls, and sulfides. Qualitative chemical analysis confirmed the presence of these homologous groups except for organic acids that were decomposed upon formation by the high pH maintained within the manure storage pit. Physiological odor investigations were conducted to indicate the important compounds in the specific odors in swine buildings. Results indicated that the major odor constituents are from the amine and sulfide groups. (Author summary modified)

13143

Henley, Don E., William H. Glaze, and J. K. G. Silvey

ISOLATION AND IDENTIFICATION OF AN ODOR COMPOUND PRODUCED BY A SELECTED AQUATIC ACTINOMYCETE. Environ. Sci. Technol., 3(3): 268-271, March 1969. 23 refs.

Actinomycetes have been reported to turn river water a brownish color and to release a musty odor. A method is presented for obtaining pure samples of materials which are reported to cause odors from actinomycetes cultures, and the structural elucidation of one of the components is described. A Streptomyces cinnamoneus strain was grown in culture media, and the odor-laden gas produced was collected and removed from the culture to a trap containing dichloromethane at -10 C. Gas-liquid chromatography revealed the presence of several compounds in the effluent gas. Spectroscopic properties of one major component suggested the structure of 5-methyl-3-heptanone, which was confirmed by comparison with standard reference spectra.

13367

Kniebes, Duane V., J. Adrian Chisholm, and Robert C. Stubbs

DIRECT ODOR LEVEL MEASUREMENT INSTRUMENTATION. Gas Age, 136(8): 24-27, Aug. 1969. 4 refs.

Odor thresholds of natural gas are conventionally measured by personnel who sniff gas-air mixtures, different operators obtaining somewhat different results due to normal variations in olfactory sensitivity. These variations are eliminated by the use of the Odotron, a new portable instrument which directly measures sulfur compounds in natural gas and provides for the translation of this measurement into the odor intensity of the gas. Although the instrument represents advanced technology, it is expected to perform well in the field because of well-tested, commercially available components. These include a gas sampling valve and liquid injection port, a chromatographic column contained in a temperature-controlled oven, and a flame photometric detector with photomultiplier and amplifier circuits. The instrument has not as yet been subjected to extensive field tests. Thus, it has not been possible to test the method for translation of detector output to total gas odor level on a wide variety of gases. Refinement of the combing rules is anticipated as more field data become available.

13627

Shigeta, Yoshihiro

ODOR PROBLEM IN ROOMS. I. ODOR MEASUREMENT. (Shitsunai Kankyoka ni okeru Shuki mondai. I. Shutoshite Shuki Sokuteiho ni tsuite.) Text in Japanese. Kuki Seijo (Clean Air - J. Japan Air Cleaning Assoc., Tokyo), 6(5):62-70, Nov. 1968. 5 refs.

The delay in the treatment of odor problems is mainly due to the lack of proper method of odor measurement. An Odor Study Group was formed in 1965 and studies on odor measurement have been carried out by the following five methods: olfactory method, Kitagawa's detecting tube method, dilution method, absorption method, and gas chromatography. The most common method for evaluating odor at the present time is by the sense of smell. The proper selection and appropriate training of technicians is mandatory for this purpose. These technicians must memorize and be able to differentiate about 60 to 70 kinds of odor. They are also required to express the degrees of odor with proper expressions. In order to express these results numerically, the ASTM dilution method or non-odoring chamber method has been used. Individual sensitivity differences and difference in modes of expression among the technicians are still unavoidable, although the differences are minimal. Using the non-odoring chamber, standard concentration levels (threshold, unpleasant, and hazardous concentrations) have been obtained for hydrogen sulfide, trimethylamine, and ammonia.

13749

Burnett, William E.

AIR POLLUTION FROM ANIMAL WASTES: DETERMINATION OF MALODORS BY GAS CHROMATOGRAPHIC AND ORGANOLEPTIC TECHNIQUES. Environ. Sci. Technol., 3(8):744-749, Aug. 1969. 21 refs.

A combination of gas chromatographic and organoleptic techniques was used to determine the chemical compounds responsible for the offensive odor of accumulated liquid poultry manure. The volatile odorous substances were trapped and concentrated in short sections of gas chromatographic columns held at -78 C, separated by gas chromatography and identified by the correspondence between relative retention time and the odors of the peaks for the unknowns and authentic compounds. Mercaptans, sulfides, and diketones were identified. Volatile organic acids and the nitrogen heterocycles, indole and skatole, were also identified, using direct injections of liquid manure supernatant and standard gas chromatographic techniques. The sulfur compounds, organic acids, and skatole were implicated as important malodorous components involved in air pollution. Prevention of the odor causing substances, rather than the use of masking chemicals, was suggested as the best means of control. (Author abstract modified)

13969

Krotoszynski, B. K. and A. Dravnieks

ODOR-RELEVANT MEASUREMENT OF ODOROUS POLLUTANTS IN AIR. Preprint, Air Pollution Control Assoc., 17p., 1968. 6 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Assoc., St. Paul, Minn., June 23-27, 1968, Paper 68-17.)

Equilibration sampling, a recently developed technique for measurement of ppb concentrations of organic vapors in air, is described. This method facilitates the analysis of air for odorants characteristic of the sources in the environment and the comparison of the concentrations of these odorants in air with their threshold concentrations. The air sampler consists of a glass cylinder equipped with two stainless steel screens between which Teflon powder, coated with Apiezon L film, can be maintained in a floating state by air sample rapidly pulled through the sampler by means of a battery-powered air fan. Vapors dissolve in the film until an equilibrium is reached; the collected vapors are then transferred to a gas chromatograph and analyzed. One of the advantages of the technique is that the headspace of the sampler contains odor of approximately the same intensity and quality as the original air, and the films contain a sufficient reserve of odorants to keep supplying odor for a period of time sufficient for psychophysical evaluation in the laboratory. The method can be easily adapted to calibration in terms of odor thresholds without an intermediate need for calibration by weight or concentration, and the original gas chromatogram can be converted to a representation in terms of odor threshold units of each odorant, enabling an improved comparison of the odorant components. This permits judgements to be made on the factor by which the concentration of an odorant in air and in the emission from its source must be reduced to suppress its value to a given level below threshold. Theoretical considerations and experimental procedures are described, and some results are given showing determination of group thresholds and of peak areas at group threshold concentrations for selected pollutants.

14108

Wilby, Frank V.

VARIATION IN RECOGNITION ODOR THRESHOLD OF A PANEL. Preprint, Air Pollution Control Assoc., Pittsburgh, 17p., 1968. 6 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Assoc., St. Paul, Minn., June 23-27, 1968, Paper 68-16.)

Recognition odor thresholds of an untrained panel of 35 people were determined for several mercaptans, organic sulfides, di- and trisulfides, and hydrogen sulfide, a total of 18 compounds. This was part of a study to correlate the odor strength of natural gas with its sulfur analysis. The panel was selected to approximate the age and sex distribution of the adult U. S. population. Other than to exclude anosmics, olfactory acuity was not a factor in selecting the panel. For each test of each odor, a hundred- fold range of concentration was presented to the panel in eleven increments of the fifth root of ten. A concentration of zero was also included. The range of concentrations was selected so as to present concentrations above and below the olfactory thresholds of all panelists. Data are presented on the variations in odor threshold of individuals at different times to the same compound, and of the panel to each of a series of 18 compounds. An attempt also was made to identify anomalous olfactory responses of specific individuals to specific compounds. Results of this phase of the study tended to confirm the assumption that in general a person's olfactory sensitivity is fairly constant, and indicated that odor threshold anomalies do exist, however, more data is required before they can be measured accurately.

14109

Leonardos, Gregory, David A. Kendall, and Nancy J. Barnard

ODOR THRESHOLD DETERMINATIONS OF 53 ODORANT CHEMICALS. Preprint, Air Pollution Control Assoc., Pittsburgh, 23p., 1968. 4 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Assoc., St. Paul, Minn., June 23-27, 1968, Paper 68-13.)

Recognition odor thresholds for 53 commercially important chemicals were determined in the laboratory by an expert panel of four members. By standardizing the method of sample presentation and minimizing extraneous sensory interference, the concentrations determined as producing the minimum identifiable odor response provided consistent and internally comparable data for one parameter of odor. The odorants were presented to the panel in a static air system utilizing a low-odor background air as the dilution medium. The odor threshold was defined as the first concentration at which all panel members were able to recognize the odor. Aspects of human odor detection and of the concept of the odor threshold are discussed. The thresholds determined for each odorant in terms of parts per million by volume are presented. The minimum threshold observed was with trimethyl amine at 0.00021 ppm. As a group, compounds with sulfur had the lowest thresholds of the compounds tested. It was noted that carbon disulfide, sulfur dichloride, and sulfur dioxide affect the other chemical senses (taste and feel) as well. The presence of unsaturation in an odorant chemical was not found to be associated with low threshold concentrations, and it is observed that extended generalizations pertaining to the odor threshold based on similar chemical structures cannot easily be made. With reference to benzenoid-type materials, substitution on the benzene ring reduced the odor threshold by as much as a thousandfold depending on the nature of the group added, and in general produced a wide variation in thresholds. Three chemicals, toluene, styrene, and tolylene diisocyanate were purified by a gas-liquid chromatography to note the effect of chemical purity on the odor threshold; differences from thresholds determined from starting materials seemed slight, if any.

14197

Binder, Heinrich

GAS-CHROMATOGRAPHIC INVESTIGATION OF VAPOUR PHASES. II. CRITICAL EXAMINATION OF DIFFERENT METHODS OF SAMPLING. (Zur gas-chromatographischen Untersuchung von Dampfphasen. II. Beurteilung verschiedner Methoden der Probennahme). Text in German. Z. Anal. Chem. (Munich), 244(6):353-359, 1969. 104 refs.

Odors, engine exhausts, aroma and cigarette smoke, urban air pollution, and quality of foodstuffs are among the problems that can be investigated by gas-chromatographic vapor phase analysis. Completeness of qualitative analysis and accuracy of quantitative analysis depend mainly on the type of collection and on enrichment and introduction of the sample. Several collection problems and the methods of their solution are described in detail. (Author summary modified)

14606

Reckner, Louis R.

DIESEL ODOR MEASUREMENT. Franklin Inst. Research Labs., Philadelphia, Pa., Materials Science and Engineering Dept. and Public Health Service, Durham, N. C., National Air Pollution Control Administration, Proc. First Natl. Symp. on Heterogeneous Catalysis for Control of Air Pollution, Philadelphia, Pa., Nov. 1968, p. 199-208.

A procedure for measuring the intensity of diesel exhaust odor using human panelists was developed and evaluated. Requirements in developing the odor panel techniques were an exhaust dilution and panel exposure system, a method of selecting and training panelists, a set of diesel odor intensity standards, and the design of the test program. The dilution and panel exposure consisted of a face box and exhaust diluted with air at the engine exhaust pipe reaching the sniff box in 4 sec and a residence time of 15 sec. Panelists were selected by testing the olfactory ability of a large number of candidates. Twelve bottle standards were used in which odorants were dissolved in mineral oil and each successive bottle had twice the concentration as that in the previous one. Panelists were trained using peppermint and cinnamon to identify the twelve bottle standards by number and to rate diluted exhaust in a sniff box. When this was done satisfactorily, test programs were run. Test programs were designed to facilitate statistical analysis. Three engine operating conditions and four exhaust dilutions were used. Each test condition was presented once in each of the four sessions. Results showed that this procedure can be used to draw statistically valid conclusions concerning the effect of parameters such as engine types, operating conditions, and fuels upon diesel exhaust odor intensity.

14607

Skala, H., F. G. Padrta, and P. C. Samson

DIESEL ENGINE POLLUTANTS. PART I. IDENTIFICATION. Franklin Inst. Research Labs., Philadelphia, Pa., Materials Science and Engineering Dept. and Public Health Service, Durham, N. C., National Air Pollution Control Administration, Proc. First Natl. Symp. on Heterogeneous Catalysis for Control of Air Pollution, Philadelphia, Pa., Nov. 1968, p. 209-220.

High molecular weight organic constituents of diesel exhaust other than unburned diesel fuel were identified. Samples were collected by the use of a thermal gradient trap from a slip stream off the total exhaust effluent. The organic pollutants were partitioned out with n-hexane. A portion of the diesel odor concentrate was subjected to additional separation over silica gel. Identification of the components was made by mass spectrometry. The pollutants were found to be partially oxidized components of the diesel fuel over its full molecular weight range. Five different classes of oxygenated hydrocarbons were found: aldehydes and ketones, carboxylic acids, alcohols, phenols, and nitrophenols. These yielded a total of over 400 observable species. Aldehydes and ketone derivatives of paraffins, cycloparaffins, olefins, and aromatics were observed. In the aromatic series, benzaldehyde, indanone, cinnamaldehyde, indenone, naphthaldehyde, acenaphthenone, and fluorenone and their higher homologues were found. The aromatic carbonyl compounds were the predominant species. The vital role of the aromatic oxygenates in the diesel odor picture was further substantiated by the absence of diesel odor in the exhaust when a fuel consisting of only n-paraffins was used. The precursors of diesel odor are therefore considered to be primarily the aromatics present in diesel fuel. Their observed relative enrichment is reasonable when one considers the relative rates for oxidation of a paraffin versus an aromatic. For aromatics, oxidation to intermediate compounds is faster than for paraffins, and complete oxidation is slower.

14680

Wagner, T. O.

COMPOSITION OF DIESEL EXHAUST HYDROCARBONS. Franklin Inst. Research Labs., Philadelphia, Pa., Materials Science and Engineering Dept. and Public Health Service, Durham, N. C., National Air Pollution Control Administration, Proc. First Natl. Symp. on Heterogeneous Catalysis for Control of Air Pollution, Philadelphia, Pa., Nov. 1968, p. 241-252.

The technology required to develop an odor standard for diesel engines is being acquired. However, diesel exhausts contain such a wide range of compounds that sampling and analytical procedures are difficult. When no more than an inventory of hydrocarbon compounds is desired, capillary-column chromatographic analysis of a bag sample is adequate, even though many 'heavy' hydrocarbons are lost. Such an analysis revealed the presence of C1 to C18 paraffins. Few, if any, of the light and mid-boiling compounds were present in the fuel. Compounds causing diesel odor are in the C8 to C18 range. Diesel exhaust contains many oxygenated compounds which may be relevant to odor, but their concentrations are low. The effect of fuel on diesel emissions is small. Concentrations of hydrocarbons in diesel exhaust, adjusted for excess-air dilution, are generally below passenger car emission standards.

15287

Zur Muehlen, Thorkill

MEASUREMENTS OF STYRENE EMISSIONS AND IMMISSIONS WITH THE AID OF GAS CHROMATOGRAPHY. (Messungen von Styrol-Emissionen und -Immissionen mit Hilfe der Gaschromatographie). Text in German. Zentr. Arbeitsmed. Arbeitsschutz, vol. 18:41-43, Feb. 1968. 15 refs.

Air samples for determining the concentration of styrene fumes in the vicinity of a processing plant for polyester resin were obtained with a gas collecting tube. A membrane pump was used to draw in 30 1 air within a period of 5 minutes. In the gas chromatographic analysis of the samples; helium (99.99%) was used as a carrier gas and the operating temperature was 150 C. Calibration was performed according to the method described by J. May. At the outlet of the vapors, 340 ppm were measured; at a distance of 1 m, 130 ppm, at a distance of 10 m, 8 to 9 ppm; and at a distance of about 35 m, about 1 ppm. The odor threshold for styrene was found to be 1 ppm.

15677

Jutzi, W.

TESTING OF METHODS FOR REDUCTION OF ODOR EMISSIONS. (Pruefung von Verfahren zur Reduktion von Geruchsemissionen). Text in German. Z. Praeventivmed., 14(5):305-306, 1969. 1 ref.

The Swiss Federal Material Testing Institute for Industrie and Construction (EMPA) developed a new method for determining the odor intensity of emissions. Large, continuous samples of the waste gas are mixed with fresh air. The latter is cleaned with activated charcoal prior to its use. The mixture is passed through a steel or plastic pipe of about 40 cm inside diameter to the persons judging odor intensity. This method is more complicated than the common method of obtaining one sample, mixing it with clean air, and having a test person determine the odor intensity but it is more easily reproducible and more representative. Two such pipes are used to judge the efficiency of a method for the reduction of odors.

16080

Lindvall, Thomas

MEASUREMENT OF ODOROUS AIR POLLUTANTS. (Bestamning av luktande luftfororeningar). Nord. Hyg. Tidskr., 47(21):41-71, 1966. 91 refs. Translated from Swedish. Franklin Inst. Research Labs., Philadelphia, Pa., Science Info. Services, 44p., Aug. 14, 1969.

Methods for determining odorous air pollutants are described, with special emphasis on the organoleptic principle. The physiological and psychological background of odor is considered incompletely investigated. Existing knowledge of the organoleptic principle of measurement permits an approach to the problem of odors from the viewpoint of environmental hygiene. The most important dimension of an odor is its acceptability, but a quantitative determination cannot be obtained. Consequently determination of odor threshold is done by studying the number of dilutions necessary to arrive at odorlessness. Difficulties connected with psycho-physical studies include lack of individual consistency, effects of adaptation, and background variables of climatological, psychological, and biological origin. Different psychometric methods including principles of stimulus presentation and indicator response in threshold studies. Principles of direct scaling of supraliminal intensities, and different kinds of olfactometers were discussed. Odor thresholds for pure substances given in literature are not compatible. This is probably because of inaccuracy of the physical/chemical methods of analysis, lack of conformity in definitions, exposure equipments psychometric methods, selection of subjects, and statistical treatment. There may also be an interaction between different odorous compounds, with respect to the resulting strength of smell, that is not always a simple matter of addition. Annoyance effects are considered to be best studied by epidemiological methods where a reliable description of the exposure can be obtained. (Author summary modified)

16134

Atsumi, Michisato, Hiroshi Kiyozumi, Kazuko Ito, Teruyuki Sudo, and Tsunako Oshima

AN INVESTIGATION OF AIR POLLUTION BY ODOR—ESPECIALLY THE COMPARISON OF THE AIR POLLUTION IN AND OUT OF PLANTS. (Akushu ni yoru taiki osen chosa—toku ni kojo naigai ni okeru hikaku kenkyu). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 3(7):407-410, July 15, 1967. 5 refs.

Comparative measurements of indoor and outdoor air pollution are reported for two petroleum plants in Yokkaichi city. Instantaneous concentration measurement methods were used: the instant an odor became offensive air was collected and analyzed by gas chromatography. The two plants were comparatively isolated from other plants. Inside one plant, numerous ground-level pollutants of high density were detected. On the leeward side of the plant a variety of substances was also present, but in smaller concentrations. Few pollutants were detected on the windward side. Certain substances were detected at a point one km to the west of the plant; less odorous substances were in most cases detectable 100 meters away. Under certain conditions the reverse occurred. The data obtained by gas chromatographic analyses are tabulated.

16298

Fiala, Ernst and Ernst-Georg Zeschmann

ANNOYANCE CAUSED BY ODOROUS EXHAUST GASES. (Laestigkeit von Abgasgeruch). Text in German. VDI (Ver. Deut. Ingr.) Z. (Duesseldorf), 109(24):1139-1141, 1967. 5 refs.

The intensity of odors caused by automobile exhaust gases was evaluated by measuring the odor intensity of dilutions of the exhaust gas with fresh air that exceeded the odor threshold. The tests were performed with a water-cooled four-cylinder, four- stroke Otto engine. The measurements were based on the following considerations. At low traffic density i.e., on well-ventilated streets, the exhaust gas odor is not noticeable; the odor threshold is not reached. With increasing traffic density, i.e., less ventilation, odor threshold is exceeded. The mass flows emitted under the latter condition were indicative of the dilution which was the measure for the odor intensity. The results showed the familiar independence of carbon monoxide and hydrocarbon concentrations from engine operating state. Test personnel could smell the exhaust gas independently of the operating state at 800- to 1000-fold dilution. The carbon monoxide and hydrocarbon concentrations at the moment the odor threshold was exceeded were between 1 and 100 ppm and 0.6 to 8 ppm, respectively. Addition of air in the exhaust system reduced the concentrations, but increased the odor intensity.

16442

Reckner, Louis R. and Robert E. Squires

DIESEL EXHAUST COMPOSITION AND ODOR. (FINAL REPORT FOR PERIOD DEC. 3, 1967 TO JUNE 30, 1968). Scott Research Labs., Inc., Perkasie, Pa., USPHS Div. of Air Pollution Contract PH 86-67-134, SRL Proj. 1076, 106p., Sept. 3, 1968. 7 refs. (Presented in part at the First National Symposium on Heterogeneous Catalysis for Control of Air Pollution, Philadelphia, Pa., Nov. 1968.)

Reliable techniques for measuring the intensity of diesel exhaust odor using human panels were developed and evaluated in statistically-designed programs. These techniques employed panelists selected on the basis of superior olfactory ability and trained to rate dilute exhaust using a series of twelve concentrations of an odor intensity standard as the reference scale A test program, designed to measure the difference in intensity between exhausts produced by two fuels at three operating conditions, was evaluated using both the two-cycle and four-cycle engines. A No. 2 heating oil produced exhaust with a significantly higher intensity than that produced by a No. 2 diesel fuel at idle than at half load and full load with both the diesel fuel and heating oil. The two-cycle engine exhaust had a significantly higher intensity at full load than at half load with the diesel fuel. This program design is suitable for general use in determining exhaust intensity differences. The quality, as well as the intensity of exhaust, must be defined in order to determine exhaust acceptability in terms of human response and achieve correlation between chemical tests and panel responses. A different approach, which makes use of a technique known as selective adaption in conjunction with chromatographic separation, showed promise for characterizing diesel odor and developing adequate quality standards. It was found that selective adaption could be used to unmask minor components in odorant mixtures. Work was directed toward developing techniques for collecting exhaust carbonyls as their oxime derivatives and subsequently regenerating them for odor appraisal and identification. Reaction in aqueous and alcoholic solutions of hydroxylamine hydrochloride yielded oximes which could be converted back to carbonyls by acid hydrolysis at elevated temperatures. (Author summary modified)

16540

Watanabe, Shinya

SELECTION OF THE ODOR PANEL AND ODOR SURVEY BY THE PANEL. (Akushu hyoka paneru no sentaku to paneru chosa). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(9):557-562, Sept. 15, 1968. 21 refs.

Despite improvements in odor analizer techniques, a high level of skill is still required to evaluate the data obtained when two or more odors are mixed. It appears more accurate so far to rely on olfactory perception. An odor panel is described whose members possess an ability to identify odors with great accuracy and to grade odor concentrations. Determination of olfactory perception thresholds involves several procedures, including the widely recognized olfactgram. Another element which should be taken into consideration when selecting panel members is the individual tolerance limit of olfaction. Some persons may have a specific disposition or liability to perceive some odor. The selection of an odor panel, therefore, must be related to its objectivity; the judgment of panel members should represent that of the people or community concerned, regardless of their subjective interest. Panel size is generally determined according to its initial purpose and research scale. A mass panel composed of a thousand persons is conceivable. While examinations of individual physical and psychological factors would be difficult, such a panel would yield more accurate odor perception thresholds than smaller panels.

16754

Cleary, Graham J.

THE CLASSIFICATION OF ODOURS. Clean Air (J. Clean Air Soc. Australia New Zealand), 3(1):13-15, March 1969. 13 refs.

The classification of odors is difficult because of the inability to describe the stimulus. A number of classification systems that have been devised since 1855 are discussed. Most are subjective based on a pleasant-unpleasant reaction with subgroup classes such as fresh, pungent, etc. One system eliminates most of the subjectiveness found in earlier schemes by classifying odors on the basis of adsorption on some common surface active agents. Extension of this work should make it possible to define odor quality even more precisely.

16781

Vogh, J. W.

NATURE OF ODOR COMPONENTS IN DIESEL EXHAUST. J. Air Pollution Control Assoc., 19(10):773-777, October 1969. 7 refs.

Offensive exhaust odors are characteristic of diesel engines. One problem in control and reduction of odor is lack of understanding of odorant sources and mode of formation. The solution of this problem depends on identification of the odorants so that study of their formation and control can be undertaken. A human panel performed odor assessments in studying raw and modified diesel exhaust and synthetic blends representing portions of diesel exhaust. Their assessments were used in determining odorant identity and quantitative contribution to exhaust odor. Low molecular weight aldehydes appear to contribute little to diesel odors. The sulfur and nitrogen oxides have been examined as odorants but of these apparently only nitrogen dioxide is a potential odor contributor. (Author's Abstract)

17044

Amoore, John E.

PRIMARY ODOR CORRELATED WITH MOLECULAR SHAPE BY SCANNING COMPUTER. J. Soc. Cosmetic Chemists, 21(2):99-106, Feb. 4, 1970. 10 refs.

An experimental method is described for identifying and mapping out the chemical extent of the primary odor of isovaleric acid and its homologs and isomers (to which certain persons are specifically 'odor-blind'). The production of this primary odor requires the carboxylic acid functional group in conjunction with a limited range of molecular shapes and sizes. The odor was experimentally established by photographing a molecular isovaleric acid model in silhouette and using a pattern recognition machine to analyze the silhouette. The machine consists of a modified television camera linked directly to a computer. It scans the silhouette by means of a large, reproducible collection of random lines. The frequency with which each random line intersects the silhouette of a selected standard compound is compared with the frequencies observed for other molecular compounds. The degree of molecular similarity, assessed by 4096 random lines, is then printed out. As determined by primary odor measurements for 15 fatty acids, a strong correlation exists between molecular shape and odor quality.

17288

Baba, Yoshio

MEASUREMENT OF MALODOROUS SUBSTANCES. (Akushu seibun no sokuteiho). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 4(4):179-191, July 1969. 34 refs.

Several problems exist in measuring malodorous substances in air, the largest of which is that susceptible limits of malodorous substances are very low. Usually the value is several figures lower than the measurable value. The concentration method was adopted in order to measure them. Water and carbon dioxide were removed before that concentration was determined. The concentration tube was cooled by liquid nitrogen. The apparatus and operation of this method was difficult; therefore, easy methods were proposed. The first method is absorption by an organic solvent such as acetone, methyl alchol, ethyl alchol, and ethyl benzene. The second method is adsorption by activated charcoal which is useful for hydrocarbons containing four to six carbons. The third is a glass filter method where malodorous gases are analyzed by gas chromatography. Chemical analysis was also used. The sample gas is passed through the absorption tube with specific reagents in it and analyzed by titration or by the colorimetric method. Functional measurements were also useful. There are three functional methods for measuring waste water odor: the ASTM method, the Japan Water Service Association method, and the saline solution method. There are several functional methods for measuring odors in air: the ASTM method, the Nader method, and the odorless room method. The gas detector method is easy and fast.

17290

Hamauzu, Yoshio

ODOR PERCEPTION MEASUREMENT BY THE USE OF ODORLESS ROOM. (Mushushitsu ho ni yoru shuki kanno sokutei). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 5(12):718-723, Dec. 25, 1969. 7 refs.

The function of the olfactory organ and some problems involved in olfactory testing with the use of an odor panel, the preparation of an odorless testing room, and other problems which are commonly observed in conducting qualtitative odor measurements were described. It is characteristic of the olfactory organ that the duration of odor perception is an extremely limited function, due to quick fatigue. This was construed to be a function of adjustment. Of nearly 2,000,000 chemical compounds which are known, one-fifth or 400,000 compounds, have odor, but only one percent of the one-fifth have pleasant odors. Empirica attempts were aimed at systematizing odor and the function of olfactory organ according to a scientific method, but they were not very successful. For this reason the measurement of odor perception is largely dependent on use of an odor panel or an observation group. Subjective judgement may be unavoidable in an olfaction test. To minimize measurement errors several conditions are required: people around 20 years have the most perceptible olfaction; sensitivity declines with age and the most qualified persons are between 20 and 40 years old; very few differences exist between males and females, but an equal number of both should compose a panel; mental and physical health is of primary importance; and reasonableness and stability of both olfactory perception and the judgement standard decide success to a great extent. The triangle test, the matching test, the ranking test, and others can be applied for panel screening. Procedures of odor perception measurement by the use of an odorless room were explained.

17627

Okita, Toshiichi, Masao Mishima, and Fumimichi Shigeta

OFFENSIVE ODORS. 6. COLLECTION AND ANALYSIS OF OFFENSIVE ODOR BY GAS CHROMATOGRAPHY (THIRD REPORT). COLLECTION AND ANALYSIS OF AMINES. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 4p.

A method of collecting and analyzing amines is discussed. The amines used in the tests were m, d, t-methylamines, which are the most difficult to collect and separate. The results of examination of the various types of packing materials showed that Chromosorb W (60-80 mesh) is the most suitable with TEP (diglycerol 15%, tetraethylenepentamine 5%, and potassium hydroxide 2%) applied to it. The column was 3 m long, with a temperature of 80 C. A Hitachi Model KGL-2 Gas Chromatograph was used, and the measurement was made with a hydrogen-flame detector. An aqueous solution of methylamine was diluted with water, and after neutralization titration, measurements were made. The retention time and minimum quantity detected for each of the methylamines are shown in tabular form. A collection of 99% was obtained when trimethylamine was collected with a glass fiber filter dipped in a 20% aqueous solution of sulfuric acid and then dried. Satisfactory results were also obtained when glass beads were used as packing.

17628

Ohira, Toshi, Minoru Takeda, Tatsukichi Ishiguro, and Osamu Koyama

OFFENSIVE ODORS. 7. GAS CHROMATOGRAPHIC ANALYSIS OF OFFENSIVE ODOR AT PLANTS HANDLING FISH ENTRAILS AND BONES. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 4p.

The offensive odors emitted by chemical plants treating fish entrails and bones were analyzed by gas chromatography. The solid reaction tube concentration gas chromatographic analysis method for ammonia and amines was used. To concentrate the samples, a glass tube packed with glass beads coated with oxalic acid was used, and air was drawn into it and passed through it to be collected. Satisfactory results were obtained with No. 0-2 glass filters. A pump was used for suction, and the volume of air collected was measured by a wet flowmeter. Each sample was transferred to a decomposition tube, a concentrated solution of potassium hydroxide was added to liberate the ammonia and amines, and these were flushed out with air. The gas was collected in a GC sample tube cooled by liquid oxygen, flushed out with heat, and introduced into the gas chromatograph. Most of the analytical values obtained showed that ammonia, trimethylamines, and pyrrole compounds are dominant, and that the proportion of other amines is low. High molecular compounds in the air decrease, and ammonia, which decomposes last, increases as the process proceeds.

17629

Kato, Tatsuo, Zensho Munakata, Tatsuji Takahashi, and Tomoaki Kawaguchi

OFFENSIVE ODORS. 8. A STUDY OF THE CONTAINER USED IN GAS CHROMATOGRAPHIC ANALYSIS FOR COLLECTING THE ODOR SAMPLE. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 4p.

An investigation of the container used in gas chromatography was conducted. The capacity of the collection container was 1 liter, and a glass vacuum collection container with a Teflon-glass screw cock was constructed. The cock had a vacuum O-ring, and the sample made contact with it when passing in and out. To test the stability of the container in the sampling process and preservation of materials of 100 ppm, hydrogen sulfide, mercaptans, and dialkyl sulfides were used as sample materials. Gas chromatographic analysis with a sample collection vessel of this type can be used as a standard method with an error of less than 6%, if the concentration operation begins within 5 to 7 hours.

17638

Sakuma, Kenzo, Taku Miura, Toru Domon, Koshiro Kanazawa, Shinichi Harima, and Taichiro Namiki

OFFENSIVE ODORS. 17. MEASUREMENT OF ODOR BY SENSORY PERCEPTION WITH THE USE OF AN ODOR-FREE ROOM. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 6p.

The threshold values for hydrogen sulfide and trimethylamine were studied. The odor-free room, used for the test, was cubic in shape, covered with stainless steel, and of an interior volume of 7.5 cu m. The room had a water-wash device and, in an upper part, a ventilation fan to change the air. Also, a small fan for agitation was attached to ensure adequate diffusion of the sample. The sample was either injected through a window or introduced by some other method. The single substances used in the tests were H2S filled in a bomb, and a 30% aqueous solution of trimethylamine. The latter was used in 1%, 0.1%, and 0.01% alcoholic solutions. The panel for the odor measurement consisted of six investigators. The necessary amount of H2S was taken by a syringe and injected through the window for the sensory test. The trimethylamine was placed in a watch glass and volatilized in the middle of the room. After agitation of the air in the room for one minute, the panelists entered. The threshold value for H2S was 0.005 ppm; the environmental offensive odor was 20 ppm; and the public hazard offensive odor level was 150 ppm. For trimethylamine, 0.0003 ppm was the threshold value; 0.002 ppm the environmental offensive odor; and 3 ppm the public hazard offensive odor level.

17639

Nakamura, Ken, Shozo Fukuda, and Harumi Hirayama

OFFENSIVE ODORS. 18. OFFENSIVE ODOR MEASUREMENT BY DETECTION TUBE. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-5 1967. Translated from Japanese. 4p.

The measurement of offensive odor constituents by the detection tube method is widely used. An investigation was conducted to determine the best conditions for measurement. Measurement conditions are being established to compare deodorizers of the direct addition type. The odor emitting source was put in the container of the device (a brown 2 liter bottle), a deodorizer was added, and air was introduced at a velocity of one liter/minute. The time when the flow began was made the starting time, and after a certain period of time, the aspirator was stopped. The odor volume was immediately measured by the detection tube. Sample material to which no deodorizer had been added was treated in the same way. As sources of odor, ammonia, hydrogen sulfide, ethylmercaptan, and raw urine were used. The deodorizers were two types of powder, and three types of liquid. Considerable differences occurred, depending on the deodorizer. In the case of oily substances, the effectiveness of deodorization by entrapment of odor was quite high, being more effective than the deodorizer itself.

17640

Shigeta, Yoshihiro, Shigeo Kobayashi, Michio Hayashino, and Yoshimasa Koyama

OFFENSIVE ODORS. 19. SENSORY PERCEPTION MEASUREMENT OF ODOR BY THE AIR DILUTION METHOD. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 7p.

The Olfacto-tester is a device for sensory perception measurements of odor using the air dilution method as its basis. A 300 ml portion of the prepared odor was put into the odor generating device and aerated when flowing at a rate of 3600 ml/min through a glass tube inserted 1 cm deep in the liquid. Measurement was done by the gradation method. The gradation levels were: 0 - odorless, 1 - faint odor, 2 - weak odor, 3 - fairly strong odor, 4 - strong odor, and 5 - violent odor. The odors of hydrogen sulfide, trimethylamine, isovaleric acid, diallyldisulfide, and ethylmercaptan were selected for study. Tests were also conducted on feces and urine, and lean fish solubles. The average value of level 1 was made the threshold value, and the average value of level 3, the environmental offensive odor level. The concentration of diluted odor of ammonia was measured with the Kitagawa-type detector tube, and was compared with the theoretical dilution concentration at the same multiple. In these experiments, there were differences between the odor dilution multiples of flowmeter and the actual measurement values of ammonia by detection tube. Reasons for this discrepancy are given.

17641

Nakagawa, Fumiyuki, Shoji Kuwata, Hiroyuki Sugiyama, and Tsutomu Yoshioka

OFFENSIVE ODORS. 20. OFFENSIVE ODOR MEASUREMENT BY THE SALINE SOLUTION EQUILIBRATION METHOD. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 3p.

With respect to the saline solution equilibration method for measuring offensive odors, such factors as kind of odor, its concentration, draft volume, draft time, and filter were studied. The odor emitting substance was put in a sample bottle, aerated, and the offensive odor gas was absorbed in saline solution. When the solution was saturated and reached equilibrium, the concentrations in the first and second absorption bottles were presumed to be equal and maintaining a definite concentration. The dilution multiple when the saline solution was diluted with pure, odorless water until the odor disappeared, represents the degree of bad odor. Some substances which readily dissolve in water do not reach saturation in 4-5 hours. Ammonia reaches equilibrium in 2-3 hours, but draft volume effect seems to be fairly large. It seems to be questionable as to whether a general standard for the length of time required can be established, since the time to reach saturation varies with substances and concentrations. The attainment of saturation and equilibrium can be assumed when the concentration in the first absorption bottle has become constant. A comparative examination of glass filters and commercial diffusers was conducted, but no great difference was observed.

18093

Smith, Hermes O. and Arthur D. Hochstettler

DETERMINATION OF ODOR THRESHOLDS IN AIR USING C14-LABELED COMPOUNDS TO MONITOR CONCENTRATIONS. Environ. Sci. Technol., 3(2):169-170, Feb. 1969. 1 ref.

The minimum identifiable odor levels of compounds in air were determined using a static dilution technique. Since adsorption of the compounds on the surfaces of equipment during the diluting procedures can potentially cause unknown and high errors, it is important to determine the true concentration in the air at the minimum identifiable odor level concentration. The authors do this by using C14-labeled compounds and scintillation counting. Results for styrene, monochlorobenzene, and monochloroacetic acid are reported. (Author's Abstract)

18194

Sullivan, D. C., D. F. Adams, and F. A. Young

DESIGN OF AN 'ODOR PERCEPTION AND OBJECTIONABILITY THRESHOLD' TEST FACILITY. Atmos. Environ., 2(2):121-133, March 1968. 25 refs.

The design requirements for the study of the thresholds of odor perception and objectionability within a large population of human subjects are discussed. The collection of an adequate body of data was facilitated by the conversion of a 35 ft. bus into an air conditioned, mobile odor perception laboratory containing six identical face exposure chambers, each providing a different, known, controlled (and readily changeable) odor concentration. The mobility of the laboratory permits the evaluation of the responses of diverse groups of test subjects at fairs, expositions, elementary schools and universities. A dynamic system of odor generation is used which provides a range of concentrations within the exposure chambers from ppm to at least 1 ppb. Subjects consecutively sample the test atmospheres from the six chambers, each containing a different concentration of the same compound. Ascending, descending and random presentation of concentrations have been employed. Concentrations range from undetectable to detectable by most subjects. The test subjects report, for each chamber, whether or not an odor is detected and whether their response to the odor was pleasant or unpleasant. In addition, each subject provides comprehensive information concerning many variables including age, sex, smoking habits, respiratory abnormalities, and occupation. These data are transferred to punched cards and analyzed for possible significant influence upon the response to odor levels. (Author Abstract)

19051

McGinnity, J. L., K. W. Grimley, Jr., C. R. Horres, Jr., and J. D. Mulik

MOBILE SOURCE SAMPLING LABORATORY FOR THE PULP AND PAPER INDUSTRY. Preprint, Public Health Service, Durham, N. C., National Air Pollution Control Administration, 12p., 1970. 7 refs. (Presented at a Symposium on Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, June 1-5, 1970.)

A mobile source-sampling laboratory for the pulp and paper industry is discussed. A continuously operating stack-gas- conditioning system has been devised for the laboratory. From the source, the gas sample first passes through a heated glass-fiber filter to remove particulates, and then into a 3/16-inch-ID Teflon sampling line. The continuous gas monitoring instruments provide analysis for oxygen, carbon monoxide, carbon dioxide, hydrocarbons, and various sulfur compounds. Seven instruments are used: two gas chromatographs, a Melpar total sulfur analyzer, a Barton titrator, and a Beckman O2, CO2, and CO analyzer. Another part of the source sampling program is an odor panel. Samples are diluted in 100 ml syringes and presented to the panel directly from the syringe. Emission data are available for gas samples taken before and after the direct contact evaporators, recovery furnace precipitator, smelt dissolving tank, lime kiln scrubber, and multiple effect evaporator scrubbers.

20100

Hurn, R. W. and W. F. Marshall

TECHNIQUES FOR DIESEL EMISSIONS MEASUREMENT. SAE (Soc. Automotive Engrs.) Trans., 77(2):1492-1501, 1969. 10 refs. (Paper 680418.)

The differences between diesel and gasoline exhausts result primarily from differences between characteristics of the air/fuel mixtures inherent in the respective combustion cycles; in addition, physical states are markedly different between the two engine types. The diesel engine operates with its air-intake unthrottled. The concentrations of the material to be measured are lowered as a result of dilution by the excess air and, with an appreciable quantity of oxygen in the hot exhaust gases, post combustion oxidation may occur to introduce problems in preserving sample integrity. Diesel mixture is heterogeneous with infinite variation in fuel richness throughout the combustion zone. Hydrocarbon is determined by a flame ionization technique in which a heated detector and sampling system are essential, but difficulties are encountered in sampling control, absolute calibration, and probable nonuniform response to different hydrocarbon species. High resolution gas chromatography is the only means by which the complex mixture of hydrocarbon in diesel exhaust can be determined in any detail. The technique for total oxides of nitrogen involves the sum of nitric oxide and nitrogen dioxide determined separately by nondispersive infrared and ultraviolet methods, but results are subject to uncertainty due both to loss of NO2 and to product reaction. Formaldehyde is determined by the chromotropic-acid procedure, and other aldehydes are determined using a modified version of the 3-methyl-2-benzothioazolone test. While the absolute values from determinations by these methods are not considered reliable, useful information is available from relative values and directional changes that they may indicate. Diesel smoke is determined using a light extinction smokemeter as specified in Federal standards for 1970 vehicles or, alternatively, using the specified instrument fitted with a smoke tube in a closed smoke conductor circuit. No instrumental or analytical procedure is useful in evaluating diesel odor, but a human panel is used for subjective measurement, and observations are referred to standard reference materials.

20192

Trieff, Norman M., William Colver, Stephen Field, Karl L. Gabriel, and Anil K. Mukherji

ISOLATION OF ODOROUS COMPONENTS PRESENT IN RENDERING PLANT EMISSIONS. Preprint, Drexel Inst. of Technology, Philadelphia, Pa., Environmental Engineering and Science Program and Drexel Inst. of Technology, Philadelphia, Pa., Dept. of Chemistry, 11p., 1968 (?). 4 refs.

Attempts were made to isolate odorous components responsible for the odor of rendering plant emissions. Three techniques were used: adsorption of odors on charcoal followed by solvent extraction; solvent extraction of rendering plant products; and extraction of solid from a Hi-volume filter. In each case analysis was done by the infrared spectra. The first technique gave negative results; the second and third methods detected the presence of a n-butylhexanoate or a congener. The musky odor of the extract was different from the mixed odor of the extract was different from the mixed odor of the commercial product suggesting the presence in the extract of other components in amounts too small to be detected. One of the components could be hexanoic acid, which presumably has a low threshold dilution level and, therefore, could be detected organoleptically at a level much lower than that required for infrared analysis. The component could also be the congener n-ethylhexanoate, which has virtually the same infrared spectrum as hexanoic acid. It is concluded that the musky type of odorous emission from rendering plants is a highly complex emission containing a number of odorous components.

20202

Okita, T.

FILTER METHOD FOR THE DETERMINATION OF TRACE QUANTITIES OF AMINES, MERCAPTANS, AND ORGANIC SULPHIDES IN THE ATMOSPHERE. Atmos. Environ., vol. 4:93-102, 1970. 9 refs.

Low-molecular weight mercaptans, dimethyl sulfide, and methylamine are the dominant malodorous pollutants in Japanese urban and industrial areas. For measuring environmental concentrations of these gases, glass fiber filters were first stored in a silica get dessicator and then impregnated with mercuric salts and sulfuric acid. Air was drawn through the filters at 100 1 reciprocal min by a commercial air-cleaner blower. Sampling time ranged from 10 to 30 min. After collection, the gases were recovered from the filters, concentrated, and analyzed by a gas chromatograph with a flame ionization detector. This method enables gases to be determined in concentrations of 1 ppb or less, although olefins collected by the mercuric salts are a source of interference. Electron capture or electroconductivity detectors would eliminate such interference. Measured concentrations of the gases at five sampling stations are tabulated, and chromatograms are shown of the gases sampled at a primary school, pulp mill, and fish meal plant.

20264

Shigeta, Y., Y. Hoshika, S. Tsuchibashi, and T. Ishiguro

THE ESTABLISHMENT OF MEASUREMENT FOR THE BAD ODOR NUISANCES. (Akushukoga kihonchosaho no ichihoko). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):85, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.)

The investigation of odor pollution is based on the obnoxiousness and the intensity of odor. Various mechanical odor measurement devices such as gas chromatography and infrared spectroscopy are not complete in that they do not measure obnoxiousness or low- threshold odors. In the United States, instrumental as well as organoleptic tests are used by means of an odor panel. Several suggestions are made as to the basic steps in the odor investigation. The investigation is broken down into three parts: the source, the environment and the questionnaire investigations, and some technical procedures are recommended.

20460

Yamamoto, Tadashi, Shozo Matsuda, Toshihide Okuno,
Hideki Tanaka, and Masahiko Tsuji

OFFENSIVE ODORS. 5. ANALYSIS OF THE CONSTITUENTS OF OFFENSIVE ODORS EMITTED FROM PETROLEUM REFINERIES. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-59, 1967. Translated from Japanese. 3p.

An analysis of the offensive odors emitted by petroleum refineries is discussed. The samples which were analyzed included liquid fractions of petroleum collected and separated from an ejector drain of a reduced pressure distillation device; contact tower drainings from the sulfuric acid washing process; and odor constituents collected by active carbon adsorption. Gas chromatography was used for the analyses. The first two samples were heated to 40 C, and a definite quantity of the gas in the container was directly introduced into the gas chromatograph for qualitative analysis. More than 30 hydrocarbons were identified. For the confirmation of these components, the elimination process with H2SO4 and other chemicals was conducted at the same time. A comparative analysis of the gas volumes evolved at different temperatures of the sample was conducted by varying the heating temperature. The third sample was also analyzed by gas chromatography, and when compared with the other constituents, a correlation was found between the detected constituents. The low-boiling hydrocarbons showed qualitative agreement, but the high-boiling ones gave inconclusive results.

20538

Franzky, Ulrich

EMISSION MEASUREMENTS ON DRYING OVENS AND JELLYING CHANNELS WITH SECONDARY WASTE-GAS PURIFYING PLANTS FOR ODOR ABATEMENT. Staub (English translation from German of: Staub, Reinhaltung Luft), 29(1):33-41, Jan. 1969. 9 refs.

Waste gases from ovens used for drying or baking colors have an intense odor due to the solvents and softeners emitted. For this reason, the government of North Rhine-Westphalia is limiting the carbon content of the combustible organic substances in undiluted, purified waste gas from drying ovens to 300 mg/cu m STP. A new technique will permit sampling for carbon concentrations between 100 and 300 mg/cu m STP. A heated probe aspirates a sample from the waste gas through a quartz tube filled with silica gel. The combustible organic substances are absorbed in the process. During subsequent treatment in the laboratory, the samples are desorbed in a flow of hot oxygen and combusted to carbon dioxide, the quantity of which is analytically determined. Emission measurements obtained by the method are reported for three polyvinyl chloride jellying channels and four continuous or quasi-continuous lacquer drying ovens. A plant that combined waste gas purification by catalytic combustion with waste-gas feedback achieved satisfactory reductions in the total amount of combustible substances present in the flue gas.

20624

Okuno, T., M. Tsuiji, and T. Yamamoto

THE SNIFF TEST OF ODOR SUBSTANCES BY OLFACT-TESTER. PART I. (Olfact-tester o michiita shukiseibun no kanno tesuto 1). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):114, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.)

Most odor-producing substances fall under the following categories: ammonia-amine-type nitrogen compounds, hydrogen sulfide and mercaptan-type sulfur compounds, low-grade fatty acid compounds, and paraffin-olefin hydrocarbons. Odor thresholds were determined for amine-type compounds by means of an odor panel without prior specific training as well as an 'olfact-tester' developed by Nader. The instrument was modified so that vacuum pumping could be performed after each testing in order to prevent the prior odors from lingering in the pipes. The concentration of the odorous elements were measured by gas-chromatography and an infrared absorption equipment. The odor-producing compounds investigated were methylamine, ethylamine, n-propylamine, and n-butylamine; the experimental results are tabulated according to molecular weight, boiling point (C), gas-chromatographic relative gram-molecular sensitivity, odor threshold (ppm), specific weight (20 C), and purity w/w (%).

21208

Fujii, Soichi

MEASUREMENT OF INTERIOR ENVIRONMENT AND ITS EVALUATION. (Shitsunaikankyo no sokutei to hyokaho soron). Text in Japanese. Kuki Seijo (Clean Air-J. Japan Air Cleaning Assoc., Tokyo), 7(6):1-4, March 1, 1970.

Though evaluations of interior environments have been extended to cover comfort and sanitation, the attainment of satisfactory living and working conditions will also require measurements of factors impercaptible to sensory organs. The eight kinds of measurements suggested in this paper comprise the following: (1) interior temperatures, which determine well-being to a great extent; (2) relative humidity; (3) radiant heat from both ceilings and walls; (4) air stream agreeable in summer but hot in winter; (5) cleanliness of indoor air where major contaminants are dusts, toxic gases, noxious odors, and bacteria and, in some cases, the amount of atmospheric ions; (6) ventilation; which may not actually be necessary if the air is clean; (7) illumination, involving intensity of light, light distribution, glare or intrusion of direct rays of the sun, and color of light; and (8) noise, which is difficult to measure. It is recommended that suitable criteria be provided for four categories of indoor environments: ideal, good, average, and the worst allowable limit.

21652

Ekman, G.

QUANTITATIVE PRINCIPLES OF ADAPTATION AND RECOVERY. Karl Marx Univ., Leipzig (East Germany), Symp. Biokybernetik, 1st Intern., Leipzig, E. Germany, 1967, p. 141-146. 4 refs. (Sept. 19-22).

Adaptation and recovery were studied in the modalities of olfaction and vision. By developing scaling methods for measuring perceptual or subjective variables, an attempt was made to measure the sensory intensity as perceived by the observing subject. Subjects were exposed to a continuous flow of hydrogen sulfide in air, and estimates were obtained of the perceived intensity of odor at regular intervals. Results are shown graphically. With increasing time of exposure the perceived intensity diminishes until it becomes practically asymptotic after 10 minutes. An exponential function is given for the adaptation process. Measurements were also obtained during and immediately following recovery period, in which the trend was one of initially very rapid but successively slower growth. Full sensitivity was recovered after about five minutes. In the vision experiments, the subject's task was to estimate the brightness perceived by the dark-adapting eye in relation to the brightness perceived by the pre-adapted eye. Perceived brightness was seen to grow with the time of dark-adaptation according to two negatively accelerated curves intersecting at about 8 min. The data is described as the sum of two logarithmic functions.

21693

Reckner, L. R. and R. E. Squires

DIESEL EXHAUST ODOR MEASUREMENT USING HUMAN PANELS. SAE (Soc. Automotive Engrs.) Trans., 77(3):1694-1705, 1968. 13 refs.

A technique for measuring the intensity of diesel exhaust odor using a human panel has been developed and evaluated. While the ratings are primarily useful for comparative tests, the degrees of difference which can be shown to be significantly small to make the procedure adequate for practical use. A system was constructed which allowed presentation of diesel exhaust to a panel at controlled dilutions in a manner simulating on-the-street exposure. The panelists were selected on the basis of superior olfactory ability, and were trained to rate the odor of diluted diesel exhaust against a series of 12 odor intensity standards. The exhaust was diluted at the engine exhaust pipe and flowed dynamically through the presentation system to maintain its quality and intensity. The panelists were exposed to the diluted exhaust in a 1/2 cu ft sniff box for approximately 5 sec. The standard deviations of the panelists' responses were significantly higher at 1200 and 600 dilutions. This indicated the panel ratings were less reproducible at low concentrations, and more reliable results were obtained at concentrations with higher intensities.

21858

Nakagawa, F., S. Kuwata, H. Sugiyama, and K. Obata

THE MEASUREMENT OF ODOR WITH PORTABLE ODOR ABSORBING APPARATUS. (Shuken kinoshita shiki shuki sokootei sohchi ni yoloo shukido sokootei (III)). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):117, 1969. (Proceedings of the Japan Society of Air Pollution Annual Meeting, 10th, 1969.)

A portable odor level determining instrument has been constructed; some experiments were conducted to know the range of its application and the relationship between measured odor level and the concentrations of the sources. This instrument, in priciple, gives the odor level in terms of a multiple of dilution when the liquid, which originally odorless (pure water), has absorbed the odor and reached the equilibrium with it, and loses its odor by dilution with odorless liquid (pure water, again). Hydrogen sulfide loses its odor too quickly to measure the odor level. For methyl mercaptan, odor levels are 40, 80, and 200 for source concentrations of 1, 2, and 3 ppm, respectively. Dimethyl sulfide gives 100 odor level against 300 ppm of concentration. As a result, this instrument standardizes the odor measurement and would be used for amines, ammonia, and mercaptans. However, odors from matter insoluble in water or ones not easily absorbed have to be studied. In addition, the data on the relationship between sources and odor level has to be obtained.

21859

Okita, T., R. Sugai, and I. Kifune

SAMPLING AND ANALYSIS BY FILTER METHOD OF MALODOROUS GASES IN THE ATMOSPHERE. (Akooshu no sokootei V Loshishiki sampler ni yoloo yuki ioh kagohbootsoo no hoshu boonsekihon no kentoh narabini ryukasooiso oyobi aldehyde rooi sokootei eno ohyoh). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):118, 1969. (Proceedings of the Japan Society of Air Pollution Annual Meeting, 10th, 1969.)

To determine malodors in the environment, filter type sampler for sampling organic sulfur compounds using mercury compounds was earlier introduced. Since then, the following items on sampling and analysis, by means of gas chromatography, of ethyl mercaptan, methyl mercaptan, and dimethyl sulfide were examined. In the process of the analysis (sampling, separation, and concentration), moisture should be removed before concentrating the sample with potassium carbonate and soda lime. The velocity in concentrating the sample with liquid oxygen is 0.2 l/min. The retention time of each sample gas can be remarkably reduced if the column temperature is 47 C, the flowrate of a carrier gas (N2) 30 l/min, and the column length 2.25 m. The reproducibility of this method is approximately 6% in terms of variation coefficients. Filters compared (Tohyoh No. 6 filter, AAWP millipore filter, and glass fiber A filter) show the collection efficiency from 44% to 100%, depending on the gases. This method is applied for gases in the water and the air polluted by waste from pulp and petroleum refining industries to show 6.0-7.8 ppb of methyl mercaptan, 2.9-3.7 ppb ethyl mercaptan, and 5.1-7.2 ppb of dimethyl sulfide in river water and 4.0-5.2 ppb of methyl mercaptan and 2.3-3 ppb dimethyl sulfide in the air.

21866

Domon, Toru, Yoshio Hamauzu, Shinichi Harima, and Yoshihiro Shigeta

SELECTION OF ODOR PANEL AND ITS DEVELOPMENT FOR THE INVESTIGATION ON PUBLIC NUISANCE DUE TO OFFENSIVE SMELL. (Akushu kogai chosa ni okeru paneru no sentei to ikuseiho). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 5(12):714-717, Dec. 25, 1969. 2 refs.

A survey was conducted to establish general standards for an olfactory perception test, to test the ability of olfactory judgment, to test the ability to rank odors, and to test olfactory ability compared to group odor quality. Qualitative odor judgment examines the ability to tell one odor from another. Odor samples, chosen from both 'enosmophore' and 'kukosmophore' groups were given to 20 candidates each in two rooms with a time limit of five minutes. Consideration was given to the way odor samples could reduce olfaction fatigue, therefore odor samples grew stronger. The text included two questions in each odor group: the ranking of odor samples and the identification of odor samples. Results of the tests which were conducted twice with three month intervals showed 52.9% of the passing rate with 36 candidates of the total 68 candidates the first time, reaching 56 points as the passing mark. The highest passing rate was in the forties and the lowest in the fifties the first time; the second time, the forties marked a great deal inverse passing rate and the twenties attained the highest passing rate. The rate of correct response concealed the fact that the lower rate of correct responses found in 'kukosmophore' group was interpreted to mean that the odor group was harder to be ranked than the 'enosmophore' group. It was added that the number of candidates probably was not large enough to draw a conclusion.

22431

Hoshika, Yasuyuki

TWO OR THREE EXAMPLES OF PUBLIC NUISANCE DUE TO BAD-SMELL. (Akushu kogai chosa no nisan no jirei). Text in Japanese. Akushu No Kenkyu (Odor Res. J. Japan), 1(1):28-36, April 20, 1970.

In Japan, the number of complaints against obnoxious odor has rapidly increased. Broadly speaking, this is not due to the rapid increase of sources but to increased public awareness. People's consciousness of interest in noxious odors has increased since the air pollution, water pollution, or noise became big issues. Noxiou odor was not well defined, and it is still difficult to define the odor nuisance. The range of the odor sources has become extremely large. Urbanization has developed a great deal. Techniques and funds for odor prevention are lacking. As a starting point of odor prevention, a survey was made of factories emitting noxious odors. A processing factory for fish entrails and bones and a pharmaceutical plant were chosen for this purpose. The survey consisted of a questionnaire and odor test. The test included organoleptic tests, such as the odorless chamber method ASTM injector method, and Kinoshita method, and instrumental analyses, such as gas chromatography, ultraviolet, visible, and infra-red spectroscopy, mass spectoscopy, and nuclear magnetic resonance. By correlating these two sets of data, organoleptic and instrumental, the measurement of odor pollution can be quite reliable. Analysis and discussion of the data obtained are given.

22448

Colucci, Joseph M. and Gerald J. Barnes

EVALUATION OF VEHICLE EXHAUST GAS ODOR INTENSITY USING NATURAL DILUTION. Preprint, Society of Automotive Engineers, Inc., New York, 10p., 1970. 9 refs. (Presented at the Automotive Engineering Congress, Detroit, Mich., Jan. 12-16, 1970, Paper 700105.)

Although exhaust gas odorants are generally a product of engine and fuel parameters, it is the vehicle that the public associates with exhaust odor. The vehicle and its movements have a large influence on the dispersion of exhaust odorants and, therefore, on the actual public exposure to exhaust odor. A considerable amount of public exposure to vehicle exhaust odor results from municipal operation of diesel-powered buses, especially during the bus-stop sequence. Panel test procedures are developed for field evaluation of full-scale vehicle exhaust odor intensity during the idle and acceleration portions of a simulated bus-stop sequence. Odor tests, based on natural dilution of the vehicle exhaust to the odor threshold, are conducted in a controlled environment, indoors in large buildings. Different degrees of exhaust dilution are achieved by randomly varying the distance from the test vehicle to the panelists. Panelists are required to make yes-or-no decisions on whether or not they can detect an odor above the background level. Exhaust odor intensity is expressed in terms of the threshold response distance, with greater threshold response distances indicating greater exhaust odor intensity. The test procedures give adequate repeatability. Six repeat idle tests with one bus give threshold response distances ranging from 27-32 ft, averaging 29 ft. Four repeat acceleration tests with another bus gave threshold response distances ranging from 32-41 ft, averaging 36 ft. Idle tests with two different busses in two different test facilities show repeatable differences in the exhaust odor intensity, indicating that the procedure is capable of discriminating between two odor sources of differing intensity. (Author abstract modified)

22958

Wohlers, Henry C.

ODOR INTENSITY AND ODOR TRAVEL FROM INDUSTRIAL SOURCES. Intern. J. Air Water Pollution (London), vol. 7:71-78, 1963. 4 refs.

Odor surveys were completed of stack effluents and in the vicinity of a petroleum coking plant, a kraft-paper mill, an onion and garlic dehydrating plant, and a retrogravure printing plant. Gas samples were taken by the evacuated bulb technique or by passing sufficient stack gas through a bottle to replace the original air in the bottle. Threshold measurements were made with an osmoscope consisting of two telescoping metal tubes complexly arranged for odor dilution with clean air. The odor intensity in the environs of the industrial plant was determined subjectively while driving in a car at constant speed (30-35 mph) with the wind-wing of the driver's window open so that the oncoming air was directed at the face of the observer. When the extent of the odor travel from these plants was compared with the calculated threshold dilution of the stack gases according to Sutton's equation, the odor measurements at the stacks did not agree in all cases with the calculated dilutions at the distances in the field where the odors were noted. Unless the diffusion coefficients are experimentally determined, the Sutton equation should not be used for distances greater than 2 miles; at distances greater than 1 or 2 miles under unstable conditions, the stack height, the exit velocity, and the temperature of the exhaust gases no longer seriously affect the plume axis concentrations. The osmoscope, which assumes the validity of the Weber-Fechner law, had an error of no larger than about 25%. The consequence of the logarithmic relation of this law is that a 10-fold reduction in odor concentration makes a scarcely perceptible alteration in the strength of the odor. This relation must be considered in making field odor surveys. It is suggested that these results are another example of only partially diluted stack gases moving as discrete eddies through the atmosphere. (Author abstract modified)

23004

Ohkita, Toshikazu and Masao Watanabe

MEASUREMENT OF MALODOUROUS GAS BY GAS CHROMATOGRAPHY. (Gasukuromatogurafu ni yoru akushu gasu no sokutei). Text in Japanese. Akusho no kenkyu (Odor Research J. Japan), 1(1):16-27, April 20, 1970.

Either qualitative or quantitative measurement of an odorous gas by conventional methods are extremely difficult because of its low density and because it is frequently a mixture of several kinds of different gases. Also, the intensity of the odor is affected by human factors and environmental conditions such as humidity or temperature. Scattering of data is observed in the detection threshold, but very little in recognition threshold values. Gas chromatography is employed in the analysis because normally odorous gas is a mixture of gases, each component of which can be analyzed by the method. Also, the development of high-sensitivity detectors such as flame ionization, electron capture, coulometric, and flame photometric detectors, contributed to more use of the gas chromatograph. Experimental procedures of the methods such as calibration for amine, mercaptan, and organic sulfide, and gas collections by cooled organic solvents, filtration with reagents, and powder surface cooled by liquid oxygen are described. Field measurements are also presented together with the method of gas collection at the source. The application of gas chromatography for the qualitative analysis of excretal smell is given in detail. Several methods of gas collection, including organic solvents and U-tube cooled by liquid oxygen, are described together with gas chromatogram and infra-red spectrum.

23106

Kikuchi, Kaku

EXAMPLES OF ODOR MEASUREMENT AT KRAFT PULP MILLS. (Kurafuto parupukojo no shukisokutei jirei). Text in Japanese. Akushu no Kenkyu (J. of Odor Control), 1(1):9-18, April 20, 1970.

A unique method of measuring odorant concentration developed at Tohoku University. This is a new type of organoleptic method based on the olfactory reaction to determine odor perception thresholds which are numerically expressed. It is also noteworthy that this method is legally authorized to be the only valid means of odor measurement and to be employed as such for air pollution control. The flowchart of the apparatus used for the olfactory test as well as the present odor removal equipments which the kraft pulp mills are operating are illustrated. The principle of this method is based on Henry's law that a gas is saturated in proportion to its partial pressure in the atmosphere after it has been passed through water for a while. The maximum dilution multiplier for the saturated solution which is determined by olfactory sense provides the standard for the obnoxious odor level. The sampled gas needs to be passed through the duct filled with salt water until the concentration of the gas arising from the salt water becomes tantamount to its original level in the atmosphere. The sample solution thus obtained have to be promptly examined by an odor panel because some gases dissolve very readily. The application of this olfactorium to gaseous emissions from both the blow tank and the recovery boiler in a kraft pulp mill was made, and the values obtained showed 700 and 200 respectively. The basic value of 200 was determined from a fish-meal factory). The results of tests conducted on each one of the processes involved in kraft pulp mills by use of this salt water olfactorium are presented in the form of graphs and tables.

23107

Terabe, Mototsugu

MEASUREMENT OF AIR POLLUTION AND SOME ASSOCIATED PROBLEMS. (Taikiosen no sokutei to nisan no mondaiten). Text in Japanese. Kukichowa to Reito (Air Conditioning Refrig.), 10(2):56-64, Jan. 15, 1970. 3 refs.

The methods of atmospheric pollutant measurement are divided into two groups: one dealing with the environmental density of pollutants and the other at the sources with the flue gas or automotive exhausts. For the latter, a number of Japanese Industrial Standards has recently been established. For the measurement of falling dusts, a deposit gauge and a dust jar are used. For the suspended dusts or fumes, three kinds of samplers, tape, high-volume, or Andersen samplers, are described. Sulfur oxides in the air are monitored by lead dioxide, rosaniline or electro-conductivity methods. Electro-conductivity is not affected by NO2 existing witn SO2, but is considerably dependent on Cl, HCl, or NH3. The rosaniline method, on the other hand, is affected by NO2, which can be counteracted by sodium azide of sulfamine acid. Nitrogen oxides, NO2 or NO, are monitored by Saltzman, phenol disulfonic acid, or an automatic continuous method utilizing colorimetry. The automatic recorders can be calibrated by a permeation tube. An example employing DuPont's fluorinated ethylene propylene resin is described. For the measurement of odor in the atmosphere, the ASTM method, a dilution method, is recommended. Definitions of an odor unit, concentration, and emission rate are given, together with a method of calculating odor concentration and odor threshold. For the details of the measurement the reader is referred to the references.

23755

Frey, Allan H.

ELECTRO-OLFACTOGRAM TECHNIQUE AND INTERPRETATION. Randomline. Inc. Willow Grove, Pa., ONR Contract N0014-69-C-0181, 16p., Nov. 1969. 9 refs. CFSTI, DDC: AD 705520

Experiments bearing on the controversy regarding the interpretation of the electro-olfactogram are reported, in which frog olfactory receptor tissue was examined microscopically after exposure in an experimental chamber to either odorized or ambient air. The technique incorporated new controls, involving laminar airflow conditions and care in identifying and patterning the electrostatic environment that earlier work had indicated to be necessary in EOG studies. Three different patterns of EOG could be obtained from the same preparation as a function of the controls used. The classic negative voltage response was obtained when the olfactory receptor tissue was exposed to the classic high velocity puff of odorized air without the new controls. A slowly developing negativ voltage response to odorized air was obtained when the tissue was exposed to low velocity but not laminar flowing odorized air. In contrast, a biphasic wave with a large initial positive component was obtained when laminar flowing air was used and the electrostatic environment was controlled. Placement of the electrode in non-olfactory tissue as a control indicates that the latter effect is not electrochemical. Thus it appears that much of the controversy in the olfactory literature may result in part from the use of a classic though unreliable stimulated technique as well as from possible confounding of several effects in the past literature. (Author abstract modified)

24071

Barynin, Jan

MEASURING ODOUR POLLUTION. New Scientist, 48(723):116-119, Oct. 15, 1970.

The prospects are considered of introducing scientific standards for assessing odor pollution as an aid towards legislation on odor abatement. In much previous work on odors, human beings were subjected to different concentrations of odorous materials under artificial conditions in laboratories. However, the present experiments were conducted out-of-doors with a photomultiplier tube, and observer responses were compared with the detector curves. A typical experiment which is illustrated suggest that the nose and the detector have similar sensitivities and that the olfactory threshold for methylmercaptan is a few micrograms/cu m. What the records did not indicate was the variety of other sensations experienced.

24429

Skinner, C. F.

ODOR CONTROL. Nat. Eng., 74(7):12-14, July 1970. (Presented at the National Association of Power Engineers, Pollution Control Conference, 2nd Annual, Chicago, Ill., Nov. 12, 1969.)

An odor unit is defined as the quantity of any odor or mixture of odors which, when dispersed in one cu ft of oder-free air, produces a median threshold odor detection response. A dilution method has been developed that uses the human nose to measure odor concentration. It consists, in essence, of successively diluting a gas sample with odor-free air until a threshold dilution is reached; that is, at further dilution no odor is detectable by the human nose. Odor concentration is determined by plotting dilution response on log-probability coordinates. The choice of panel members should be limited to those with the most generally reliable olfactory perception, and the odor evaluation room should be designed to minimize the possibility of extraneous odors in the vicinity of the panelists. Most organic materials and inorganic combustibles such as ammonia, hydrogen sulfide, and cyanide gases can be effectively destroyed by incineration methods. Basic design requirements for incinerators are the same for both the catalytic and thermal methods. Systems must provide thorough mixing of the combustibles with air, enough heat input to raise the temperature of the gas stream to the required level for oxidation, even temperature and flow distribution, and sufficient dwell time to accomplish the degree of oxidation required. In a catalytic system, dwell time is the time the gases spend in the catalyst bed, while in a thermal incinerator, dwell time is a function of the size of the holding chamber, which is determined on the basis of exhaust flow rate. Catalytic systems and thermal incineration are discussed in more detail.

24814

Okita, Toshiichi

CHEMISTRY OF SMELL. (Nioi no kagaku). Text in Japanese. Eisei Kagaku (J. Hyg. Chem.), 16(5):235-240, Oct. 31, 1970. 5 refs.

Various theories on the mechanism of sense of smell are described, but there is no definite experimental method of confirmation yet established, which calls for a more biological explanation. Analyses by the use of instruments, started only recently, and was made possible with the development of gas chromatography. Threshold values and odor descriptions for some 50 chemicals are listed. Various methods of trapping a gas were investigated. Organic solvents such as alcohol, acetone, or ethylbenzene, are cooled with a dry ice-acetone refrigerant, trapping the gas with a 1 liter/min flow and introducing a part of it for gas chromatography. In a second glass method glass beads fill a U-tube which cooled with liquefied oxygen; the gas is introduced at the rate of 0.3 l/min. After the gas is trapped, the tube is fixed in the gas sampling equipment for gas chromatography. In a third method, trapping the gas with a filter, such reagents as mercury salt for mercaptan and sulfide and sulfuric acid for amines, etc., are coated on the filter. Odorous gases are trapped on the filter, the gas is separated and condensed, and either the first or second method is adopted for measurement. Infrared absorption spectra were used to identify mercaptans, sulfides, ammonia, and methane from the gas emanating from feces were identified.

25054

First, Melvin W.

A MODEL ODOR CONTROL ORDINANCE. Preprint, International Union of Air Pollution Prevention Associations, 18p., 1970. 12 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper AD-36B.)

The ability of the human nose to make odor measurements for which no instrument has yet been devised has retarded the development of objective methods for evaluating odor nuisances and the formulation of control ordinances and regulations that eliminate purely subjective judgments by control officials. A method of quantitatively evaluating and regulating odors in the atmosphere which takes into account objective measurements of odor intensity and quality, frequency and duration of exposure, and recognizes the greater annoyance associated with odors which occur at times other than the usual business hours is outlined and formulated into a model ordinance for the regulation of odor nuisances when caused by odor concentrations below the threshold of instrumental analysis or by ill-defined odor mixtures for which existing analytical methods are inadequate. The current trend in the United States of formulating odor control ordinances based on some number or percentage of complaining neighbors is critically examined as a method of odor control and rejected in favor of relying on properly trained professional air pollution control officials to make the necessary judgments for effective community odor control. (Author abstract)

25065

Cleary, Graham J.

SOME CONSIDERATIONS IN THE EVALUATION AND CONTROL OF ODORS. Preprint, International Union of Air Pollution Prevention Associations, 18p., 1970. 33 refs. (Presented at the Internationa Clean Air Congress, 2nd, Washington, D. C., 1970, Paper EN-34C.)

Variations in odor threshold values are caused mainly by subjective factors and methodology but purity of the odorivector and humidity are also important. Another factor is the nature of the relationship between stimulus and response wherein a given change in the concentration of the stimulus results in a much smaller change in the response. Because of the multiplicity of factors involved, a comparatively large and diversified population should be used to determine community threshold values. The settin of these standards would be based on a statistical analysis of the threshold data. Much more work remains to be done on the frequency-objectionability relationship and particularly on the interaction between time of exposure, concentration, and frequency of exposure of odors. Of the various collection methods, low temperature condensation has two distinct advantages, namely that the concentrated odorous material is immediately available for analysis and that the odorant is preserved without chemical reaction. Short term storage of many organic substances can be effected in plastic bags but two-film bags have been advocated, the inner film being impermeable to the gases of interest and the outer film to moisture. Factors affecting thermal and catalytic combustion, adsorption, absorption, oxidation by liquids and gases, surface condensation, process change, and physical containment of industrial odors are discussed. Thermal afterburning is the surest method of eliminating an odor problem and a temperature of 800 C of 0.3 seconds has been found satisfactory. The extent of odor travel from industrial sources in some instances is very much at variance with predictions based on Sutton's diffusion formula The main reasons for this variation are thought to be the travel of large eddies of low frequency and the difference between the fleeting concentration of an odor which for more experimental work on the extent of odor travel, on special nocturnal effects, and on diffusion of odors during atmospheric stratification is stressed. Difficulties in setting sufficient emission standards to cover the multitude of possible odor emissions might be overcome by preparing a wide range of acceptable ambient air standards and incorporating 'presumptive' emission standards whie still insisting that the best practicable means of control is to be employed. (Author abstract modified)

25466

Lindvall, Thomas

SWEDISH EXPERIENCES ON SENSORY EVALUATION OF ODOROUS AIR POLLUTANT INTENSITIES. Preprint, International Union of Air Pollution Prevention Associations, 34p., 1970. 15 refs. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper SU-18A.)

A primary concern in the investigation of the environmental hygienic annoyance effects of odorous air pollutants is to establish a relationship between the dose to which the population is exposed and the degree of annoyance experienced. A method for sensory analysis of odor intensities of air pollutants was developed, primarily as a base for a valid dose-description. Field studies were conducted using mobile odor laboratories providing standarized experimental environments independent of the location of the laboratories and the presence of odors in the vicinity. Sensory source intensity analysis at a sulfate pulp factory combined with meteorological calculations were used to predict the frequency with which odor would be discernible in the ambient air at various distances from the source. Reports made under controlled conditions by special observers display a strikingly high degree of correlation with the predictions of odor frequency in the observation area up to at least 5 km from the source. Such predictions have been used to estimate the consequences from an environmental hygienic standpoint of a planned pulp mill in a resort area in Sweden. Determinations of absolute odor thresholds were conducted at various process stages in the sulfate pulp and rock wool industries. Effects of various countermeasures have been studied and an effort has been made to correlate the chemical composition of the sulfate exhausts with their odor intensity measured by absolute odor threshold methods. The sensory method of analysis developed has displayed great applicability also for studies of exhausts from motor vehicles, combustion units, and in the handling of animal wastes. (Author abstract)

26096

Appell, Louis

ODOR INTENSITY. Am. Perfumer Cosmet., vol. 79:43-48, Feb. 1964. 7 refs.

A method is given for computing odor intensity with and without the use of standard solutions. It is based on principles that have been applied in the measurement of visual brightness and loudness of sound. Specifically, it takes the principle that the intensity of the sensation is proportional to the logarithm of the stimulus as the basis for the classification of odor intensity. Preliminary results are given for the application of the method to some aromatics and mixtures. In addition, equations are derived for estimating odor threshold values.

26309

Yoshida, Masaaki

STUDIES IN THE PSYCHOLOGY OF OLFACTION (3). QUALITATIVE CLASSIFICATION OF ODOURS. (Kyukaku ni kansuru gakusetsu (3). Te in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(3):1-9, Oct. 1970. 2 refs.

Past and present studies in the psychology of olfaction are presented. System of classifying odors were developed by Aristotle by specialists in the aromatics industry, by physiologists and psychologists, and, later, by food scientists. In 1946, Hsu applie multi-variable analysis to the result of a classification made by a panel. Yoshida applied the multiple dimension measurement method devised by Torgerson (1951) to the judgment made by a panel as to the similarity representative between 10-25 odors. Yoshida's study is objective, as is Hsu's, but it is difficult to name each factor. There is little consistency in the judgments made by laymen, while professionals in the aromatic industry have very high consistency among themselves (over 0.8), which indicates that the latter have established their own standards for classification, and also, developed a terminology for their guidance. The correlation betwee the direct approach, Crocker's classification, and the semantic differential method proves that each approach is reliable to a satisfactory extent. Similar multi-dimensional approaches were used by Engen, who applied Ekman's method, and Waskow, who had a panel judge the degree of similarity between stimulus i and stimulu j with 1-9 marks. By giving appropriate values to 1-9, the average was sought; this was made the 'distance', and the similarity of 25 odors was expressed qualitatively. The characteristics of the multi-dimensional approach is that by juding the degree of similarity or difference, without making the panel designate the degree of pleasantness, sweetness, etc., several basis for overall judgment on similarity or difference can be derived without the need of language.

26547

Okita, T.

MEASUREMENT OF AMINES, MERCAPTANS, AND ORGANIC SULFIDES IN THE ATMOSPHERE BY THE FILTER PAPER METHOD. (Roshiho o mochiita taikichu no amin, merukaputan, yuki sarufaido no sokutei). Text in Japanese. Sangyo Kogai (Ind. Public Nuisance), 5(12):703-708, Dec. 1969. 9 refs.

A filter paper method was devised in order to collect, separate, and concentrate the malodorous gases in the atmosphere and to later pass them through a gas-chromatograph for analysis. A hydrogen flame ionization detector was also used. For the separation of methyl mercaptans and dimethly sulfides, TCP was used. Mono-, di-, and trimethyl amines were separated by diglycerol, tetraethylene pentamine, and caustic soda. Collection was accomplished by refrigerated organic solvents such as ethylbenzene, acetone, and methanol and water. The gas collection rate was over 90%. Glass fiber filters were impregnated with 3% $Hg(CN)_2$ and 20% H_2SO_4 in order to recover gases; the recovery rate was 100%. In a silica-ge desicator with the filter protected from light exposure there was no loss, even three days after gas collection. When gas was captured by powder surfaces such as glass bead surfaces cooled by liquid oxygen, the retention efficiency was about 100% for the captured gas volume less than 100 microg. A filter gas sampler was constructed for sampling in the vicinity of various factories; for malodorous gases over 1 ppb, only a few minutes was necessary, although there was a possibility of contamination by olefin gases.

26837

Okuno, Toshihide, Masahiko Tsuji, and Tadashi Yamamoto

ODOR THRESHOLD DETERMINATIONS OF AMINE COMPOUNDS BY OLFACTO-TESTER. (Orufakutotesta ni yoru amin kagobutsu no kyukaku genkai nodo no sokutei). Text in Japanese. Hyogo-Ken Eisei Kenkyusho Kenkyu Hokoku (Rept. Environ. Sci. Inst. Hyogo Prefect.), no. 1:9-15, May 1970. 17 refs.

A unique olfacto-tester has been applied to aliphatic amines for th measurement of their threshold concentrations. The vessel is connected to a vacuum pump to remove substances absorbed from previous tests, a problem found with most apparatus used until now. Odorous substances which are injected into the vessel diffuse rapidly into the vacuum space and are diluted by air. Physiologically identifiable minimum concentrations in ppm of amine absorbed are as follows: primary amines (carbon 1 to carbon 4), 0.8 to 2.2 ppm; secondary amines (C2-C8), 0.1 to 0.5 ppm; tertiary amines (C3-C12), 0.05 to 0.4 ppm. As the carbon number of the amines increases, the threshold concentration decreases.

26966

Kaiser, Elmer R.

ODOR AND ITS MEASUREMENT. In: Air Pollution. Arthur C. Stern (ed.), Vol. 1, New York, Academic Press, 1962, Chap. 15, p. 509-527. 21 refs.

Part of the air pollution problem of all sizable communities is the presence of gases and vapors in the atmosphere that offend the sens of smell. The amazing sensitivity of olfactory reception is apparent from the fact that a sniff of 50 cc of air containing only 2 times 10 to the minus 9th power mg of mercaptan serves as an adequate odor stimulus. The first requirement for odor measurement is a definable and reliable yardstick. An individual perception threshold and a population perception threshold are discussed. A group of three, five, or more trained observers, each with at least an average keenness of smell, and who will follow prescribed rules, can make valuable odor determinations. The organoleptic panel technique is described, as well as the sampling of odorized air or gas. The most satisfactory determination of odor concentration is by dilution of a sample with odor-free air until the perception threshold is reached. A simple procedure of the American Society for Testing Materials is outlined. An odor evaluation apparatus has been devised by Nader, which utilizes the perception principle with continuously proportioned streams of odorous air and odor-free air. Factors affecting odor perception include concentration of th odorant in air, odor fatigue or adaptation, humidity, and temperature. Odor sources most frequently reported to air pollutio control agencies are presented tabularly, as well as the minimum concentration for positive perception of a large number of compound Odor masking and counteraction are discussed, including the cost of odor treatment.

27121

Little (Arthur D.), Inc., Cambridge, Mass.

CHEMICAL IDENTIFICATION OF THE ODOR COMPONENTS IN DIESEL ENGINE EXHAUST. (FINAL REPORT). HEW Contract CPA-22-69-63, CRC Proj. CAPE-7-68(1-69), C-71407 and C-71475, 112p., June 1970. 4 refs. NTIS: PB 194144

In the second and final year of this research program, a two-stage gas chromatographic method for resolution of diesel odor fractions was refined, using an efficient GC fraction trapping method and applying it successfully to the oily-kerosene odor fraction obtaine from the first-stage, liquid-column chromatography separation. The odors of the individually resolved compounds were characterized and their structure determined by high resolution mass spectrometry. The chemical classes associated with the oil-kerosene portion of diesel exhaust odor are alkyl benzenes, indans/tetralins, and indenes; alkyl naphthalenes may also contribute synergistically, while unburned fuel apparently contributes heavily. Some limited success was achieved in applying modifications of the GC/LCC techniques to the smoky-burnt odor fraction, and several individual odor species were identified, but detailed odor and chemical structure assignments for this odor fraction await the application of the two-stage GC approach for the study of resolved single species. Recommendations for future research are made. (Author summary modified)

27248

Organization for Economic Co-operation and Development, Paris (France), Air Management Research Group

TECHNICAL PROBLEMS IN MEASUREMENT AND MONITORING. Rept. EX.40131, 61p., Feb. 10, 1970. 89 refs.

Factors influencing the research policy on the measurement and monitoring of air pollution include recognition of the internal combustion engine as a major source, routine monitoring of specific industrial pollutants, potentially hazardous occupational conditions, atmospheric tracing and fluctuating levels, and recent developments in technology. Emerging administrative requirements of measurement are discussed, as well as priorities in research. Continuous monitoring networks are described, and predictive models are considered. Sampling and analytical techniques for asbestos, carbon monoxide, fluorides, heavy metals, fuel additives, organic compounds, nitrogen oxides, oxidants and ozone, sulfur compounds, odors, and pesticides are presented, including spectrometry, fluorescence, polarography, chromatography, Saltzman method, iodimetric methods, photometric methods, and others. Current research on the measurement of particulates below 10 micron is described. Emission inventories are described, and the principal areas of deficiency in technical capabilities are disclosed.

27355

Shigeta, Yoshihiro

ODOR POLLUTION IN THE CHEMICAL PLANT AND ITS MEASUREMENT METHOD. (Kagaku kojo ni okeru akushukogai to snon sokuteiho). Text in Japanese. Anzen Kogaku (J. Japan Soc. Safety Eng.), 9(1):20-28, Feb. 1970. 19 refs.

Sources of odor pollution include petroleum refinery, petrochemical and kraft pulping industries. Direct consequences of odor pollution depend on the pollutant. Hydrogen sulfide and mercaptans are malodorous and chlorine, acrolein, and ammonia are stimulants. The former induce headaches and sick feelings, while the latter attack eyes and throat. Indirect damages are deterioration of property, soiling, and loss of business. The damages extend to an average of 100-200 m downwind from the source, and in some cases extend as far as 4 km or even 7 km. The definition of malodorous gases is difficult, because they cannot be categorized by the industries or processes, or by harms done on the human body. Here the definition bad odor is 'odor that disgusts people' and malodorous substance is gaseous substance, sometimes containing mists and particulates, that induce disgust through olfaction. In Japan odorimetry involves odorless chamber, syringe, or Kinoshita-type (salt solution equilibrium) methods. There is also gas-chromatography such as low-temperature adsorption, vacuum bottle, or solid reactor tube methods. Methods in the U. S. include dilution by air, chemical analysis, and mechanical analysis methods. The continuous (dynamic) method falls into the category of air-dilution and uses an olfactometer or scentometer together with an odor panel. The odor panel must possess the following qualities: discrimination ability, pertinence, stability, and ability to express.

27475

Baba, Yoshio

ANALYSIS OF ODOR COMPONENT: GAS CHROMATOGRAPHIC DETERMINATION OF SULFUR COMPOUNDS BY THE FLAME PHOTOMETRIC DETECTOR. (Shuki seibun no bunseki: senko kodogata kenshutsuki tsuki gasukuromatografu ni yoru biryo iou kagbutsu butsu no bunseki). Text in Japanese. Kogai (Pollution Control), 5(4):204-215, July 1970. 13 refs.

A concentration process is described for preparing odorous sulfur compounds for gas chromatographic analysis by a flame photometric detector (FPD). Concentration is based on extraction by air, absorption by powdered celite, and subsequent cooling with dry ice-ethanol. A small amount of the absorbed sample is then placed in front of the separation column and the odor component desorbed by nitrogen carrier gas and detected by the FPD. This method was successfully used to determine hydrogen sulfide, mercaptans, and sulfides in such practically odorless substances as wood, hop, beer, and refinery waste water. Selective elimination of mercaptans in a mixture of sulfur compounds was studied to obtain a simple group analysis of sulfur compounds on the gas chromatogram. Solid absorbers were prepared by sintering aqueous solutions of metals salts on powdered celite. Mercaptans in the sulfur compounds could be removed selectively with cadmium chloride and sodium carbonate, but silver nitrate and mercuric sulfate exhibited no selectivity. The relative retention values of 19 sulfur compounds were also determined. (Author abstract modified)

27685

Ishiguro, Tatsukichi

MEASUREMENT OF RANK ODOR. (Akushu kogai no sokutei to sono boshiho). Text in Japanese. PPM (Japan), 2(2):35-47, Feb. 1971.

A quantitative indicator of rank odor is very much needed. The low concentration and multicomponent mixture of rank odors is the object of odor pollution control. Nitrogen or sulfur compounds and several kinds of organic compounds are the main substances causing bad smells. A dedorization effect is generally expected for a removal efficiency of more than 99.9-99.99%. The wide range of distribution of threshold values of rank odors also impedes rank odor control. Gas chromatography is widely used for determining rank odor. Condensation of sampled gas is the feature of this method, which has good reproducibility and separate power. Direct condensation is desired for this method, as sampled gas contains a comparatively large amount of water or carbonic acid gas. Adsorption on the surface of a packed agent makes possible the collection of a comparatively complete amount of odor particles or molecules. In comparison to all other gas chromatographic methods, the glass beads method is best in respect to preparation, handling, preservation, easy sampling, and commonness of samples. This method has been applied to hydrogen sulfide, sulfides, mercaptans, ammonia, amines, aldehydes, and several kinds of fatty acid. Mass spectrography is used as the method for qualitative analysis, especially for recognition of substances detected by gas chromatography. A sense test is adopted for quantitative determinations; to strength of odor does not necessarily agree with the concentration of odor substances detected. The air dilution method is the best of all sense tests, in spite of the adsorption of odor substances, and the mechanism of dilution. An odorless chamber is widely utilized for the method which also is applied to determine threshold value. The injector method is easy to perform and is expected to be used widely. The equilibrium method with sodium chloride is based on Henry's law and is also easy to perform.

27733

London, Sheldon A., Wilbur M. Sappington, and Barry W. Widman

EVALUATION OF FIELD INSTRUMENTATION FOR N204 AND MONOMETHYLHYDRAZINE. Aerospace Medical Research Lab., Wright- Patterson AFB, Ohio, Medical Div., Conference on Atmospheric Contamination in Confined Spaces, 5th Annual, Dayton, Ohio, 1969, p. 341-362. 23 refs. (Sept. 16-28, Paper 25.) NTIS, DDC: AD 709994

The past and present effort to develop monitoring instrumentation for liquid missile propellant operations, particularly systems of monomethylhydrazine (MMH) and nitrogen dioxide/nitrogen tetroxide, is considered. Currently available colorimetric and physico-chemical methods are reviewed, and a detailed account is given of evaluation studies of a commercially manufactured portable detector, the Olfactron Model 6110, which were conducted to determine its sensitivity and linearity of response to MMH, to ascertain the validity of MMH calibration using UDMH, and to determine the performance of a new NO2 transducer. Review of the literature and results of the present studies indicate little success in developing the desired instrument; none of the devices tested fulfilled field requirements for MMH and NO2 monitoring. Field calibration of the Olfactron with UDMH for MMH detection was not accomplished as designated by the manufacturer, and the reproducibility of the estimation of repeated exposures was limited to short term events unacceptable for operational situations. Emphasis should therefore still be placed on colorimetric methods of proven reliability. In conjunction with previously demonstrated sensitivity of olfactory detection (odor thresholds of less than 0.5 ppm for NO2 and less than 0.3 ppm for UDMH), colorimetric tubes can provide useful information until instruments and dosimeters are developed that have the required reliability.

27791

Ohira, Toshio

PRESENT STATE AND FUTURE COURSE OF RESEARCH ON OFFENSIVE ODOR, A PUBLIC NUISANCE. (Akushu kogai kenkyu no genjo oyobi hoko). Tex in Japanese. Tokyo-to Kogai Kenkyusho-ho (Tokyo Public Nuisance Res. Inst. Bull.), no. 1-3-2:1-31, March 1970.

Studies of offensive odors undertaken by the Research Institute of the Tokyo Metropolitan Government, begun in 1966 are reviewed. The Institute has been concentrating on studying the offensive odor generated in fish intestines and bone disposal plants. In 1966, the offensive odor was analyzed by gas chromatography. A gas chromatographic analysis of the offensive odor to determine amines was made in a field experiment at fish waste disposal plants. Only ammonia and trimethyl amine were detected in this analysis, conducted in 1967, perhaps because of improper sampling and pretreatment of the sample. In 1968, three types of commercially available deodorizers were tested for deodorization of the fish wastes: the ozone oxidation type (water washing-ozone addition- active carbon adsorption), venturi scrubber type, and the sulfonic carbon adsorption type. The results obtained were tabulated by type. An extracted-juice concentrator was also tested with a view toward recovering and deodorizing the useful contents. The device consisted of a juice storage tank, a separator (protein, fat, and solids), a high-speed centrifugal separator (protein separation) and vacuum concentrator (protein concentration). Among the main objectives of the 1970 study were improvement of sampling method, upgrading of gas chromatographic analysis precision (on low amine compounds and low sulfides) and comparison of three types of sense tests (non-odor chamber method, injector method, and Kinoshita method). Intermediate results of the experiments and tests were tabulated. Some of the outstanding problems that have to be solved as soon as possible include standardizing sampling methods for obtaining odorous test samples, analyzing undetermined contents contained in an offensive odor by gas/mass analyzer or through synthesization of odorous substances unobtainable commercially, and making available more complete sets of measuring instruments.

27934

Leonardos, Gregory, David A. Kendall, and Elaine R. Rubin

THE ROLE OF BACKGROUND ODOR IN AFFECTING THE PERCEPTION OF ODORANT CHEMICALS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 33p., 1970. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 63rd, St. Louis, Mo., June 14-18, 1970, Paper 70-23.)

The effect of various background odors that may exist in the environment on the perception of odorant chemicals has not been fully evaluated in a systematic manner. The information presented reports on the effects that various low-intensity background odors might have on the recognition odor threshold concentration and the perception of supra-threshold concentrations of odorant chemicals. Additional data is developed on the odor character and intensity of selected odorant chemicals as their concentration is increased above threshold levels. The odorant chemicals studies included methyl isobutyl ketone, toluene, ethyl acrylate, ethyl mercaptan, p-chlorophenol, diphenyl ether, hydrogen sulfide, and pyridine. The odor properties of these chemicals were evaluated against low- odor intensity backgrounds that included a minimal odor background as the control, a simple chemical background (hydrogen sulfide or sulfur dioxide) and complex backgrounds (gasoline, diesel exhaust or cigarette smoke). The recognition threshold concentration for methyl isobutyl ketone ranged from 0.25 ppm (0.1 ppm SO2 background to 6.3 ppm in a low-level diesel exhaust background. Methyl isobutyl ketone (concentration range of 0.63 - 2.5 ppm) interacted with diesel exhaust background to produce a qualitative change in the odor quality. The recognition threshold concentration of ethyl mercaptan in a 1.0 ppm SO2 background was 0.025 ppb as compared to a threshold concentration range of 0.25 - 0.63 ppb in the other backgrounds studied. The range of thresholds determined for p- chlorophenol was 0.025 ppb (activated carbon-treated air) to 1.0 ppb in diesel exhaust. The similarity of odor quality (burnt) of diesel exhaust and p-chlorophenol may explain the higher threshold for p-chlorophenol observed in diesel exhaust. In certain instances, background odor can have an effect on the perception of odorant. It appears that the likelihood of this occurring is enhanced if the odorant and background have similar odor descriptions or if the background is complex. It does not appear to be possible to predict the effect that background odor might have on the perception of specific odorant chemicals. Because of the complexity of the problems of odorant interaction, it is almost impossible to draw firm conclusions from the limited data available. (Author abstract modified)

28141

Stephens, Edgar R.

IDENTIFICATION OF ODORS FROM CATTLE FEED LOTS. Calif. Agr., 25(1):10-11, Jan. 1971. 2 refs.

To identify the odorant compounds from typical cattle feedlot operations and to develop suitable chemical analytical methods for their determination and measurement, a small-scale project was conducted at the State-wide Air Pollution Research Center of th University of California. Several classes of compounds which were obvious candidates for analysis included the amines, sulfur compounds, and low molecular weight organic acids. Trimethylamine, especially, is a powerful odorant very reminiscent of feedlot areas. Gas chromatography with both flame ionization and electron capture detectors was the first method of analysis chosen for odorous materials. Paper chromatography was also investigated, as were various spectrometric techniques and flame photometry. The low molecular amines were suggested to be the most important odorous compounds in feedlot air. Odor threshold values of some strong odorants are presented tabularly.

28393

Lang, Oskar and Thorkill zur Muehlen

AIR POLLUTION BY ORGANIC ACIDS AND ESTERS AND THEIR ANALYTICAL DETERMINATION. (Luftverunreinigung durch organische Saeuren und Ester und deren analytischer Nachweis). Text in German. Zbl. Arbeitsmed., no. 2:39-45, Feb. 1971. 25 refs.

Odor emissions are frequently traced to organic acids and their esters, concentration of which can be photometrically determined with the hydroxamic acid reaction. An impinger (volume 100 ml) with 50 ml saturated barium hydroxide solution is used for sampling Sampling speed is 1.8 to 2.0 cu m/hr. The pollutant to be measured is absorbed on a 10-cm layer of silica gel. The silica gel is then extracted for 30 min with 15 ml ether. For analysis, 10 ml ether solution is mixed with 2 ml diazomethane solution and the mixture heated to the boiling point. After cooling, 3 ml hydroxylamine solution is added and the mixture heated again for 10 min. The extinction is measured and compared with a control solution. The method was used to measure ricinolic acid in the waste gas of a lacquer drying oven; a concentration of 0.6 mg/cu m was measured. The method was also used for measuring methylcyclohexylacetate and for measurements at an acetylation plant.

28787

Katoh, Tatsuo, Tomohiko Ishiguro, Chikako Kakuda, Seiji Takahasi, and Takeshi Murata

TOTAL ANALYSIS OF AIR POLLUTANTS NO.22: GC-MASS ANALYSIS OF TYPICAL ODOR POLLUTION. (Taiki osen no zenbunseki. Dai-22-ho, GC-MASS ni yoru daihyoteki akushu no bunseki). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):91, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, 1970.)

Analyses of odors were attempted to gain further knowledge of gas chromatography - mass spectroscopy (GC-MASS) and to improve its efficiency and capabilities. The sample odor liberated into the atmosphere was collected in a vacuum bottle with a Teflon cock. The sample was then released by a vacuum pump in the heated state, and led through liquid oxygen to be cooled and removed to its gas-chromatography test tube. Part of the sample was analyzed by the hydrogen flame ionization method. The GC-MASS used was Shimadzu LKB 9000. For gas chromatography, helium was used as carrier gas. The sensitivity was as high as that obtained by high-sensitivity gas chromatography. Due to the rise of base at high temperature, however, the applicable temperature range was narrower. In addition, the presence of even simple components such as water or hydrogen sulfide can interfere with mass analysis.

29243

Prochazka, Vladimir and Jaromir Base

METHODS FOR EVALUATING THE RESULTS OF MEASURING THE INTENSITY OF THE ODOR OF HEATING GASES. (Vyhodnocovani mereni intenzity zapachu topnych plynu). Text in Czech. Plyn (Prague), 51(3): 70-72, 1971. 6 refs.

Attempts were made to provide an objective method of determining the intensity of odors by measuring the content of odorants, such as sulfur compounds in the air. However, this was found to be unreliable since there are cases where the simultaneous presence of certain substances which individually would cause an odor, results in an interference and a reduction in the intensity of the odor. A synergism of odors can also occur. For instance, organic sulfides have a milder odor than mercaptans, but if the two are mixed they produce an intensity of odor which is greater than the average odor intensity of the two components. As a result of these observations it was concluded that even the most perfect analytical control of the deodorant content in a gas cannot replace or eliminate the control by smell. For the intensity of odors registered by smell, a classification was adopted in which class 0.5 signifies a condition where the presence of an odor is just noticeable, class one means a weak smell, class two a warning smell, and class three a very strong smell. The sensitivity of the human olfactory organ varies among individual persons, therefore, the average classifications obtained from a number of persons related with the odorant content established by gas analysis. Class two can in some cases be equated with a condition which signifies a danger of poisonous effects or of explosiveness.

29269

Laffort, Paul

BIVALENT RELATIONSHIP BETWEEN THE OLFACTORY THRESHOLDS OF 50 PURE SUBSTANCES AND SOME OF THEIR MOLECULAR PROPERTIES. (Relation biunivoque entre les seuils olfactifs de cinquante corps purs et certaines de leurs proprietes moleculaires). Text in French. Compt. Rend. Soc. Biol. (Paris), 162(2):1704-1712, July-Dec. 1968. 12 refs.

A mathematical formula is derived from a study of 50 substances, mostly organic, which permits the calculation of the olfactory threshold in man from certain physicochemical data. The important parameters in the equation are the apolarity (A) derived from the molecular volume, the hydrogen bond index (H), and the volumetric polarizability of the octet. The group of 50 substances examined includes aliphatic hydrocarbons, common alcohols, some esters of ethyl alchol, common organic acids, ammonia, bromine, carbon disulfide, and hydrogen sulfide.

29337

Oka, Minoru

METHODS AND PROBLEMS OF MEASURING DIESEL EMISSIONS. (Haikigasu seibun no sokutei to sono mondaiten). Text in Japanese. Jidosha Gijutsu (J. Soc. Automot. Engrs. Japan), 25(3):276-282, March 1971. 5 refs.

Measurement methods of three types of diesel emissions - gaseous pollutants smoke, and odor - methods are described. For the measurement of such gaseous pollutants as carbon monoxide, nitric oxide, and hydrocarbons methods include gas chromatography, PDS (phenol desulfonic acid method), the Saltzman method, non-dispersive infrared, non-dispersive ultraviolet, and flame-ionization anaysis, and gas-liquid chromatography. The most difficult emissions to measure is HC, in that a sampled diesel exhaust gas has to be cooled rapidly in order to avoid the HC from being oxidized with the excess oxygen present; it is also necessary to keep the sampled gas at a higher temperature to avoid condensation of HC. Gas - liquid chromatography is designed for the HC measurement. Filter paper and transmission techniques to measure smoke are discussed. In the filter paper method, soot or carbon particulates in the exhaust smoke are filtered and the blackened filter paper is then compared visually with a smoke chart to determine the soot density. The transmission method involves a photoelectric device which measures the density according to the smokes light transmissivity. Measuring devices for odors are still in development stage. At present, odor is evaluated by the human sense of smell.

29508

Hoshika, Yasuyuki

A FINDING CONCERNING A BASIC INVESTIGATION METHOD ON ODOR POLLUTION SEEN FROM ACTUAL EXPERIENCE. REPORT NO. 2 ON THE STUDIES OF OBNOXIOUS ODOR. (Genbateki keiken kara mita akushu kogai kihon chosaho ni kansuru ichi kosatsu. Shuki no kenkyu dai 2 ho). Text in Japanese. Preprint, Japan Chemical Society, Tokyo, 1p., 1971. (Presented at the Japan Chemical Society, Annual Meeting, 24th, Tokyo, March 1971, Paper 3340.)

Human perception of obnoxious odors is a composite phenomenon, caused by certain chemicals in a certain combination and concentration. A survey method for obnoxious odors is presented. The first step is a statistical classification of smell characteristics. The second stage is to confirm the odor-causing substance by chemical and instrumental analyses. In the third stage a similar mixture is made by using known substances. The type and intensity of each odor should be the same as the one expressed in the first stage. Examples of raw materials for the synthesis of various kinds of amino acids are noted and a gas chromatograph of an obnoxious odor from an amino acid synthesis plant is included.

29726

Baba, Yoshio

ON MEASUREMENT OF ODOR. (Shuki no sokuteiho ni tsuite). Text in Japanese. Kogai (Hakua Shobo) Pollution Control, 6(1):50-56, Jan. 1971.

In a bill to control obnoxious odors, methylamine sulfide, methyl mercaptan and ammonia and industries such as the livestock farms, food processing, garbage treatment, and pulp manufacturing are the objects for possible control. However, although the refinery and pulp mill both emit obnoxious odors of a sulfur origin, the odor from the steaming pot of the kraft pulp mill is mostly methylmercaptan; from refinery, dozens of sulfur compounds are emitted, not just methylmercaptan. If the concentration of methylmercaptan alone is to be the measured, because the concentration of methylmercaptan from refinery is so small, the kraft pulp mill would be placed at a disadvantage. In all fairness the total amount of sulfur should be added. Based on the ASTM, the sensory test is used for the measurement of odors. In Japan, the air dilution method (olefactometer method), the pressure ratio method, salt balance method, and odorless chamber method are used. The balance method is simple to handle and is the most widely used. The weakness of the sensory method is that it cannot be used for continuous measurement of air pollutants. In using instrumental measurements, there is a problem of detecting small amounts of odor constituents and relating the intensity of the odor suffered by the people to the components of the odor. Man can detect 0.1-0.005 ppm of hydrogen sulfide and 0.01-0.0001 ppm methylmercaptan, which is difficult to measure with instruments. However, there are gas chromatographs which are very sensitive, measuring 10 to the minus ninth g. Selective use of the gas chromatograph with an adequate trapping method must be made. A method for the extraction of odor components is also described.

29843

Sakata, Ei

ENVIRONMENTAL POLLUTION AND ITS MEASUREMENTS (II). (Kogai- kankyo osen to seno sokutei (II). Text in Japanese. Shin Kinzoku Shiryo (J. Japan Soc. Newer Metals), no. 182:57-62, March 1971.

Measurement equipment is classified into the following groups: continuous autoanalyzers which are located at contaminated spots and are generally used for the measurement of one species; iinstruments which are placed in a laboratory because of the difficulty of complete automation and which have diverse uses, are versatile and apparatus used for the research on pollution control techniques. The principles, mechanisms, applications, and advantages are given for an infrared gas analyzer used for the measurement of carbon monoxide and sulfur dioxide; a visible-ultraviolet gas analyzer for nitrogen dioxide and chlorine; a conductometric analyzer for sulfur oxides; an autoanalyzer by absorptiometry for nitrogen oxides, sulfur dioxide, and oxidant; an automatic electrochemical analyzer for nitrogen oxides, sulfur dioxide, oxidant, hydrogen sulfide, and chlorine; a hydrogen flame ionization detector in a gas chromatograph for hydrocarbons, and a dust monitor. Emission spectrometry for the qualitative and quantitative analysis of metals, atomic absorption spectrometry for the qualitative and quantitative analysis of metals, atomic absorption spectrometry for the routine measurement of small numbers of metals, visible-ultraviolet spectrophotometry, fluoro-spectrophotometry, and gas chromatography for mixed samples applied to odor analysis, and mass spectrometry are also discussed.

29858

Mueller, Peter K., Evaldo L. Kothny, Louis B. Pierce, Theodore Belsky, Miles Imada, and Hezekiah Moore

AIR POLLUTION. Anal. Chem., 43(5):1R-15R, April 1971. 557 refs.

A literature review is presented of analytical activities concerning air pollution in the years 1969 and 1970. Sampling and physical properties, inorganic composition, and organic composition are discussed for suspended particulate matter. Determination methods are considered for inorganic and organic gases, as well as automated analyses; the effort is devoted mainly to sulfur and to carbon compounds. The analytical chemistry for measuring odorous pollutants does not yet provide the sensitivity of the organoleptic measurements, especially for short-term sampling. Methods of measuring biospecimens are also indicated.

29891

Karolinska Inst., Stockholm (Sweden), Dept. of Environmental Hygiene

METHODS FOR MEASURING AND EVALUATING ODOROUS AIR POLLUTANTS AT THE SOURCE AND IN THE AMBIENT AIR. 77p., 1970. 114 refs. (Discussions of Working Papers presented at the Third Karolinska Institute Symposium on Environmental Health, Methods for Measuring and Evaluating Odorous Air Pollutants at the Source and in the Ambient Air, Stockholm, Sweden, June 1-5, 1970.) Also: Nord. Hyg. Tidsk., 51(2), 1970.

Odor problems are associated with a variety of sources such as industrial installations, farm yards, and urban areas with heavy traffic. The procedure in studying environmental nuisance is ultimately based on an effort to find the relationship between the dose to which the public is exposed and the annoyance reaction displayed. A detection methodology is detailed for the following aims: to study the relative importance of various odoriferous processes in regard to the ultimate odor intensity of the emission; to study the effectiveness of various odor control systems; to measure source intensity by determining odorant levels in discharges; to forecast odor distribution and intensity at various distances from a source; and to investigate the feasibility of predicting odor intensity from the chemical and physical characteristics of the discharge. The effects on humans are also discussed. Conclusions and recommendations for future research on physicochemical methods, sensory methods, and responses to odor exposure are made.

29929

Yoshida, Masaaki

STUDIES IN THE PSYCHOLOGY OF OLFACTION. (4). QUALITATIVE CLASSIFICATION OF ODORS. (Kyukaku no riron. (4)). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(4):1-8, March 1971. 5 refs.

Studies on olfaction psychology are reviewed. Osgood's semantic differential method has been applied to the area of the senses which are difficult to express in words. In Japan, studies were made on the harmonious degree of colors, the quality of sound, and the touch of textiles. Studies on olfactory sense were made by Wright and Michels (1964), Schutz (1964), Harper-Land-Bate-Smith (1968), and Yoshida with differences in the methods used. Yoshida reported the principle of the classification of odors. Harper (1968) selected representative odorous substances that included representative chemical structures. They contain low, medium, and high ceilings and low, medium, and high degrees of pleasantness. The level of concentration used in experiments is harmless and does not change its nature for 4 weeks, even though exposed to air from time to time. Schutz seeks a correlation between the profiles of stimulant matter used as the sample by using 27 kinds plus liking and intensity. The method used by Wright and Michels examines the relationship between the infrared spectrogram and the characteristics of smells. Using nine standard substances, the panel members remembered them and evaluated the similarity of 50 substances by six steps. The credibility on similarity is very high. Since the vocabulary of many people is poor monitors with only a little knowledge and experience have less difficulty with the Schutz or Wright and Michels methods.

30014

Leithe, Wolfgang

DETERMINATION AND EVALUATION OF LOW CONCENTRATIONS OF INDUSTRIAL AIR POLLUTANTS. (Zur Bestimmung und Bewertung niedriger Konzentrationen industrieller Luftverunreinigungen). Text in German. Chemiker. Z. (Heidelberg), 95(10):452-455, 1971. 17 refs.

Common methods for the determination of small concentrations of sulfur dioxide, fluorides, oxides of nitrogen, and odorous substances are discussed. For SO2 the highly selective and sensitive West and Gaeke colorimetric method, employing rosaniline, is used. Fluorides are also determined by colorimetry, using alizarine-complexone and lanthane nitrate. Recently, fluoride-selective electrodes have also been used. For the analysis of NO2 and NO, sensitive methods are available which uses azo dyes. More recently the so-called Saltzman-reagent, N-(1-naphthyl)-ethylene diamine and sulfanilic acid, has been preferred. Gas chromatography is used to determine odorous substances. The sensitivity of this method could be greatly increased by the recently developed technique of reversion gas chromatography. The substances to be analyzed are concentrated in a tube which is filled with a suitable adsorption agent. The beginning and the end of the tube filling can be cooled and a heating sleeve can be moved across the entire tube. The method operates periodically and a complete chromatogram is obtained every 15 min. In the first period, the air sample is passed through the tube with the two cold zones in action. In the second period, the heating sleeve is moved across the tube at a speed which is below the sampling speed.

30374

Hoshika, Yasuyuki

PROPOSAL ON OBNOXIOUS ODOR SURVEY ACT (NO. 1). (Akushu kogai chosaho ni kansuru teian). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(4):39-47, March 1971.

Obnoxious odor cannot be merely a matter for scientific investigation. Even when a very small amount exists (e.g., 0.0001 ppm of methylmercaptan) it is detected by men gives an unpleasant feeling. Medico-physico-chemical evaluation is an important factor. Although the Odor Survey Act covers the physiological phenomenon of the sense of smell, the actual emission of odors by factories, the mechanism of generating odor causing material and the relationship between the factories and the inhabitants in a neighborhood, almost all the episodes must be dealt with case by case, and no methodology is established. There is no methodological approach to the odor problem because it is vague, difficult to define, and there is no appropriate method for measurement. The atmosphere, water, and filthy materials which cause odor pollution contain chemical substances in a certain combination and in a certain concentration. The only possible approach at present is to sort out the expression of people who smelled the odor (including specialists of smells), confirm the substances by instrumental analysis, approximate the concentration based on instrumental quantitative and qualitative analysis, and prepare a similar mixture of known substances to fingerprint the odor. The inhabitants reaction must be an indicator of the effectiveness of an odor eliminating device. The elimination of substances at the inlet and outlet of odor-eliminating device cannot soley be depended upon. Monitoring should be done at as many places as possible; 30, 50, 100, 200, 300, 500, 1000 m with 5-10 deg angles and at more than 10 other spots, and repeating the checks three to four times. The instruments used would be a gas chromatograph, infra-red visible, and ultra-violet spectroscopic analysis, thermo- analysis and mass spectrometry. Several instruments should be combined. For the sensory test, the ASTM method, the smelling window-odorless-chamber methods, and the Kinoshita method are applied. It is very difficult to establish emission standards on obnoxious odors.

30689

Ishiguro, Tatsukichi Isao Kobayashi, Atsuko Kobayashi, Yoshihiro Shigeta, Yasuyuki Hoshika, Tomohiko Ishiguru, and Shosaburo Dobashi

ON COMPARISON OF VARIOUS ODOR TESTS BY SMELL PANEL. (Kanno shiken kakuho no hikaku ni tsuite). Text in Japanese. Tokyo- To Kogai Kenkyusho Nenpo (Annu. Rept. Tokyo Met. Res. Inst. Environ. Prot.), vol. 2: 78-81, March 1971. 6 refs.

Three representative odor test methods using a smell panel were compared for their effectiveness: the odorless chamber with a smelling window method; the injector method; and the shuken kinoshita-shiki odor test method. The panel consisted of experts from established perfume firms. Two kinds of test samples were used, one from the exhaust gas of a drier used in a waste fish processing plant and the other from an animal bone treatment plant. The odor concentration expressed by rate of dilution required to dilute the sample with clean air to the threshold value of the odor was measured. For the sample from the fish treatment plant the value was 10,000-400,000 when tested by the odorless chamber method. The odor concentration from the animal bone treatment plant was 15,000-40,000 for a sample from a direct fire type rotary drier and 150,000-200,000 for a sample from a conventional box type drier. With the injector method, the fish waste odor was 30,000-50,000 while the animal bone odor was 750-200,000. Under the shuken kinoshita-shiki odor test method, it was 200-800 for the fish waste and 150-500 for the animal bone. Whereas the first two methods dilute the sample with clean air, the third uses water so that water-soluble substances contained in the sample, if any, may dissolve in the dilutent to change the odor. A second problem is the difference in sampling time among the three methods and the time that elapses from the time of sampling to the time of test by the panel. While it takes longer to sample with the kinoshita method, the sample remains comparatively stable. With the odorless chamber method, a longer time is required between the time of sampling and that of test, so that some measures should be taken to shorten the period. All three methods require some improvements. A better odor test method may be a combination of the injector and odorless chamber methods, using the former as the standard method and the latter as supplemental.

30704

Shoji, Hikaru, Takeo Yamamoto, Konosuke Nishida, Yasuo Yagi, and Susumu Takada

THE GAS CHROMATOGRAPHIC ANALYSIS OF THE DIGESTION GASES AND THE OFFENSIVE COMPOUNDS PRODUCED IN THE PROCESS OF NIGHT SOIL TREATMENT. Text in Japanese. Nippon Eiseigaku Zasshi (Japan J. Hyg.), 22(2):32-47, June 1967. 39 refs.

Offensive components in the night soil treatment plants where anaerobic digestion was used were analyzed by gas chromatography. The gases in the digestion tanks contained 20.6 to 27.4% carbon dioxide, 51.7 to 66.0% methane, and 0.9 to 2.0% oxygen. The gases in the tightly sealed trickling filter contained 15.0% CO2, 30.4% CH4, and 20.4% 02. The determination of aliphatic amines, ammonia, and hydrogen sulfide was carried out using a Triton X-100 and Quadol column after the samples were collected into distilled water. In the digestion tanks, there was 40.2 to 61.0 ppm total amines, 440 to 1220 ppm ammonia, and 3180 to 8068 ppm hydrogen sulfide. Aliphatic aldehydes, ethanol, aliphatic mercaptans, thioether, indol, and skatol were also determined using appropriate columns. It was suggested that mercaptans and skatol in the digestion tanks exert large effects on human olfaction. (Author abstract modified)

30811

Nakagawa, B, S. Kuwata, H. Sugiyama, and K. Obata

DATA OF ODOR MEASUREMENT BY SHUKEN KINOSHITA APPARATUS. (Shuken Kinoshita shiki shuki sokutei sochi ni yoru shukido no sokutei). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):96, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, Tokyo, Japan, 1970.)

The Shuken Kinoshita odor measuring apparatus is most sensitive to the following single elements: ammonia, amines, hydrogen sulfide, ammonium sulfide, aldehydes, and alcohols. It is less sensitive to mercaptans, dimethylsulfide, and other insoluble odors. It is insensitive to low molecule fatty acids. The odors that were detected most effectively in actual applications near odor producing factories cam from fish meal (intestines and bones), chicken excretion, soluble adsorption feed stuff, exhausts from vacuum cars (?), vitamin oil, and leftover processing (for pig feed). Less detectable odors were from animal bone processing, feather processing, marine products paste, leather, fertilizer manufacturing, and craft pulp. The instrument was insensitive to the incinerators of animal corpses and to relatively weak odors such as environmental odor. Those odors that could not be tested because of the lack of material were glue, oil fertilizer, plastic, oil refinery, petroleum chemicals, and rubber processing.

31222

Kato, Tatsuo, Shin Tanaka, and Junko Itaya

SEVERAL PROBLEMS ON TECHNIQUE OF MEASURING FOR ENVIRONMENT POLLUTION IN SMELL. (Kankyo shuki osen sokutei nikansuru gijutsujo no shomondai). Text in Japanese. Preprint, Safety Engineering Assoc., Tokyo (Japan), 36-37, 1971. (Presented at the Symposium of Safety Engineering, 2nd, May 27-28, 1971, Paper 18.)

The problem associated with the gas chromatographic analysis of odors in the atmosphere are discussed. The first problem is that gas chromatography gives an entire analytical value of the sample gas. Since the waste gas from automobiles becomes an obstacle to analysis, the selective extraction of the same kind of contaminated constituents is desirable. That is possible by causing hydrocarbon and mercury chloride, one percent in weight, to adhere to glass beads. The sample is then extracted by absorption in the glass filter. Contaminated constituents are regenerated and analyzed. Qualitative analysis is important in the study of odors. It can be done by applying gas chromatography mass analysis. Another problem is that odor in atmosphere may also come from drains. The relationship between the sense of smell and the analytical odor value should be proportional.

31924

Baba, Yoshio

MEASUREMENT/ANALYSIS OF ODOR AND TECHNIQUES OF OFFENSIVE ODOR PREVENTION. (Shuki no sokutei bunseki oyobe akushu boshi gijutsu). Text in Japanese. Preprint, Smaller Enterprises Promotion Corp. (Japan), 60p., 1971. (Presented at the Public Nuisance Prevent. Tech. Seminar, Japan, 1971.)

Odors can be measured by a human panel procedure or with analytical apparatus; the former method is used primarily to determine the intensity of an odor and/or kinds of odors, while the latter method is more often used for the analysis of substances giving a particular smell. Odorants which exist in extremely small quantities can now be detected by gas chromatographic analysis. However, it is still difficult to correlate the detected odorants and the unpleasant odor they are believed to cause. Various olfactory tests are cited. Deodorizing techniques include combustion, scrubbing, adsorption, oxidation, masking, neutralization, and a chemical deodorization method. The preventive measures implemented at the source of odor generation are cited for oil refineries, Kraft pulping, petrochemical processes, chemical processes, painting and printing industries, slaughterhouses, pig and poultry farming, and diesel or jet engine exhaust. The analysis methods are given for acrolein, formaldehydes, acetaldehyde, mercaptans, benzenes, hydrogen chloride, ammonia, and hydrogen sulfide.

32022

Purdom, Paul Walton

SOURCE MONITORING. In: Air Pollution. Arthur C. Stern (ed.), Vol. 3, 2nd ed., New York, Academic Press, 1968, Chapt. 29, p. 537-560. 54 refs.

Source monitoring is used to control processes which may cause air pollution and may be supplemented by monitoring individual processes and raw materials. Systems for determining stack emissions include the Ringelmann Smoke Chart, transmissometers, and human observations. Organoleptic methods can be used to determine odors. Automatic monitoring for particulates and gases includes electrometric, photometric, ionization, chromatographic, conductimetric, and spectrographic methods. In the past, the greatest attention has been to combustion processes. Various control agencies use source monitoring to ensure compliance with legal emission standards. Plant managements also use it to alert personnel to operating difficulties so that corrective action can be taken quickly, and to provide a record for defense for the plant where emissions are carefully controlled within allowed limits. In the future, control agencies may require plants to maintain source monitoring systems and report data to the control agency. While such efforts may raise legal questions, the principle has had wide application in the fields of waste water treatment, water purification, and milk pasteurization.

32268

Amoore, John E.

COMPUTER CORRELATION OF MOLECULAR SHAPE WITH ODOUR: A MODEL FOR STRUCTURE-ACTIVITY RELATIONSHIPS. Ciba Foundation, London (England), Taste Smell Vertebrates, Ciba Found. Symp., 1969, p. 293-312. 43 refs.

The principles underlying olfactory classification and discrimination are reviewed. Initial detectors of sapid or odorous molecules are specialized proteins, having specific affinities for particular classes of compounds. Receptor proteins, primary odors, specific anosmia to isovaleric acid, and protein receptor sites are discussed. Computer assessment of molecular shape by submitting silhouette photographs of molecular models to a pattern-recognition machine is examined. Future possibilities for correlation of structure and activity are projected, with respect to theoretical screening of large numbers of known molecular structures for valuable, but previously unrecognized, biological activities. (Author summary modified)

32269

Doving, Kjell B.

EXPERIMENTS IN OLFACTION. Ciba Foundation, London (England), Taste Smell Vertebrates, Ciba Found. Symp., 1969, p. 197-225. 55 refs.

Some analytical methods which can be used to facilitate the correlation between biological data and physicochemical parameters are examined. The mechanisms of coding the quality of the olfactory messages at different levels within the system are discussed. Electrophysiological and psychophysical data are the results of the discriminatory mechanisms. These data contain information pertinent to the question of what physicochemical parameters determine odor quality. The data from the biological experiments give matrices where the relationships between the odors are ranked. Three methods for transferring such data on the ranked relationships between odors to multidimensional scaling are examined. The results of these scaling procedures give odor spaces that are obtained exclusively on data from biological experiments. In conjunction with multidimensional scaling methods, a way of grouping the odors by a hierarchical method is described. A method by which the odor spaces are fitted and correlated to known physicochemical parameters is examined. (Author summary modified)

32467

Takagi, Sadayoshi, Tatsuo Kato, Tsugio Sawatani, Akio Tsuji, Hidetsuru Matsushita, and Takeo Miura

STUDY ON MAL-ODORS IN AIR POLLUTION. (INTERIM REPORT). (Akushu kogai ni kansuru kenkyu. (Chukan hokoku)). Text in Japanese. Study Group on Bad Odors (Japan), 42p., March 1970.

Problems pertaining to foul odors are difficult to solve or to quantitatively measure, since in perceiving them psychological aspects are involved. Characteristics, types, concentrations, and effects of odors on the physiological function of experimental animals are considered. An analytical method which utilizes gas chromatography and low-temperature condensation is described for measuring odors. Dry ice or liquid oxygen is used to adsorb the malodorous substances on diatomaceous refractory brick particles or glass beads at low-temperature. Substances used for comparison are generally mercaptans, sulfides, amines, aldehydes, or chlorides. Experiments were conducted at oil refineries, fish processing plants, and pulp mills. Another method involves solid reaction in a tube, and has a number of advantages such as moderate costs and easy preparation.

32676

Byrd, J. Floyd and Austin H. Phelps, Jr.

ODOR AND ITS MEASUREMENT. In: Air Pollution. Arthur C. Stern (ed.), Vol. 2, 2nd ed., New York, Academic Press, 1968, Chapt. 23, p. 305-327. 22 refs.

Conditions necessary for odor measurement, available techniques, and use of the data are discussed. Odor measurement at the source is easiest and most accurate for obtaining useful data. Ambient odor, however, is often weak and may be several thousand dilutions below that in the stack. It the odor is a relatively pure compound, its ordor threshold and behavior downwind can be determined by simple analytical and mathematical techniques. The relative strength of an odor is determined by dilutions. The greater the number of dilutions of odor-free air needed to bring an odorous gas to the threshold level, the stronger the odor. The best measuring device of odor is the nose. Selection of panel members is discussed. Several devices are available to inject an odorous gas into the nose, including the Fair-Wells Osmoscope, the Katz and Allison Odorometer, the syringe technique, and the Proctor and Gamble Osmo. Applications of odor measurement results to a single source, entire plant, or pilot plant are given. Odor threshold data are usually vague about techniques for determination, evaluation of the odor panel, and reliability of the observed results.

32795

Kato, Tatsuo

PRACTICAL METHOD AND APPARATUS IN ODOR POLLUTION MEASUREMENT. (Akushu sokutei no jissai to sochi). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 7(9):793-802, Sept. 1971.

The principles of gas chromatography (used in analysis of bad odor), the vacuum jar sampling method, the low temperature adsorption method, and the solid reaction tube method (beads tube method) are reviewed with illustrations. The low temperature adsorption method was redesigned and improved three times in the past eight years; it has the capacity of collecting 100 l of air sampling in 10 min and concentrating it 10 to the fifth times. It consists of the mouth, a dehydration-decarburization tube, a condenser, a suction pump, a flowmeter and a gas chromatography sampling transferring system. Soda lime and potassium carbonic acid anhydride in the dehydration-decarburization tube take out most of the carbon monoxide and water from the sampling air. The condensation pipe is a glass tube 30 cm long, 2 cm in diameter, and U-shaped, filled with refined diatom fire-brick particles. Three-way valves are attached at both ends. The suction pump also functions as a vacuum pump and has a capacity of 20 l/min, vacuum degree 0.01 mm Hg. First the large jar outside the condenser is filled with liquid oxygen and the jar is cooled. The pump starts to suction sampling air; after approximately 100 liters of sampling is collected, the cock is switched to the gas chromatography test material tube. The GC test tube is cooled. The liquid oxygen outside the condenser is taken away and the nichrome wire wound around the U-shaped tube is heated. The concentrated odor producing elements in the condenser is transferred to the GC test tube by the pump. This takes about five minutes. The GC tube cock is turned off and the material is ready for analysis.

32880

Hoshika, Yasuuki

CORRELATIVITY BETWEEN SOME ODOR MEASUREMENT METHODS USED IN ODOR SURVEY. (Akushu kogai chosa ni okeru 2-3 no shuki sokuteiho no sokanei. Text in Japne. osu o Hi(J. Water Wste, 13(:-1,Au. 1971.

A study was performed to correlate data obtained by olfactory test (ASTM syringe method) and gas chromatography. The relation between the potential of the offensive odor and the detected density of each component causing the odor was established based on the assumptions that the dilution process caused neither mechanical nor chemical errors; the olfactory sense (olfactory, discrimination, and odor threshold values) was stable and reproducible; and no chemical reactions and multiplication or offsetting of the odor take place among the odorous components. The relation between the odor dilution ratio and the detectable and olfactory threshold values of each odorousct was estimated nd applid t o ather processi la, amin acid manufactig plat, ad a kraft pulping plant. The olfactosensdetermined methyl mercaptan in the kraft pulping plant, acrolein in the feather processing plant, and ammonia, acrolein, and methyl mercaptan in the amino acid plant as the strongest odorous components.

33121

Shigeta, Yoshihiro

CONTRIBUTION OF OLFACTORY METHOD TO THE PREPARATION OF ODOR PERMISSION STANDARD. (Shukaku shiken kara no akushu kyoyo kijun sakusei e no enjo). Text in Japanese. Yosui to Haisui (J. Water Waste), 13(9):1121-1127, Sept. 1971. 7 refs.

An olfactory panel is composed mostly of inhabitants of a given area where they evaluate bad odors from the standpoint of environmental hygiene; emission sources; judgment of effectiveness of deodorants and deodorization apparatus; and investigation of emission sources. There are analytical panels composed of odor inspectors and preference panels for investigation of the reactions to various odors. General qualifications for panel members are an outstanding ability to recognize odor, appropriate standard for judgment, reliability and stability of judgment, and descriptive ability. A test was given to a group of people on June 19, 1969 which consisted of intensity recognition for 3 ppm and 6 ppm solutions of trimethyl amines; recognition of putrefied egg (solution of hydrogen sulfide), fish odor (solution of trimethyl amine), feces (scatole-isovaleric acid mixture in diethylphthalate), pickle (solution of methyl mercaptan), and burned odor (diethyl phthalate solution of pyroligneous acid oil solubles); recognition of one weak odor among two portions of 0.5% solution of orange ethanol solution and one 0.25% of the same material; and identification tests of lemon, lime, strawberry, banana, and grape oils. More than 65% right answers were considered to be passing grades; 36% of 68 people (52.9%) passed. The ratio of correct answers were 1 to 30.9%; 2 to 48.5%; 3 to 56.0%; and 4 to 50.0%.

33349

Sano, I.

CHEMISTRY OF ODOR--WITH PARTICULAR REFERENCE TO THE RECOGNITION THRESHOLD DETERMINATION. (Nioi no kagaku--ikichi o chushin to shite). Text in Japanese. Kuki Seijo (Clean Air-J. Japan Air Cleaning Assoc., Tokyo), 9(3),1-6, Aug. 1971. 4 refs.

Recent studies on the organoleptic determination of the thresholds of a number of odorous chemicals are described. The chemicals were presented to a trained panel in a test room, as well as to an untrained panel under the open sky. Sulfur-containing compounds have low thresholds on the order of parts/billion; t-butyl mercaptan exhibits a much higher threshold than would be expected; and thiophene varies considerably from test to test. Molecular chain branching might lead to enchanced odor intensity. Depending on the nature and number of the radical added, substitution on the benzene ring reduces the threshold by as much as a thousandfold. (Author abstract modified)

33577

Sawaya, Tsugio

ODOR MEASURING METHODS. (Shuki no sokuteiho). Text in Japanese. Kuki Seijo (Clean Air - J. Japan Air Cleaning Assoc., Tokyo), 9(3):7-12, Aug. 1971. 9 refs.

Methods of measuring odor producing elements in waste water from fishmeal plants or slaughter houses depends on the chemical element in the water. When the element is volatile aliphatic acid, a given amount, v ml, is taken from the total V ml. Phenolphthalein indicator is added to v. The amount of a standard solution of caustic soda (NaOH) added to the solution producing a change of color to pink is designated as A; 5-10 ml of 20% formalin solution is added to the solution causing the color to fade. The amount of NaOH producing a change to pink for the second time is B. A dry run is given to V amount of liquid and the amount of loss is designated as a. The volatile aliphatic acid (CH3COOH) in the test material (in mg) then may be calculated by: 60N multiplied by (A + B - a) and multiplied by V which is divided by v where N is NAOH concentration. Amines in the test water (CH3NH2) may be obtained in mg by: 31N multiplied by (B-a) multiplied by V which is divided by v. When the test material is alkaline, bromothymol blue indicator is added to v ml of the wastewater and HCl standard solution is added until it turns yellow. The amount of HCl is C. Separately v ml of the test water is taken and 5-10 ml of 20% formalin solution and phenolphthalein are added. The amount of NaOH standard solution that changes the material into pink is D. The amount of loss of NaOH by a dry run with v amount of liquid is d. The total weight of aliphatic acid may be obtained by 60N (D-d) multiplied by V divided by v. The weight of amines may be obtained by 31FC multiplied by V divided by v. F is HCl standard solution concentration. A method of selecting an olfactory panel and the test method using the panel, methods of producing low-concentration gases, and actual cases of fishmeal plants are discussed briefly.

34047

Saikado, Hideki

STUDY AND COUNTERMEASURES OF BAD ODORS FROM OIL REFINERY. (Seiyusho shuuki no chosa to taisaku). Text in Japanese. Sekiyu Gakkai-shi (J. Japan Petroleum Inst., Tokyo), 14(10):797-801, Oct. 1971. 2 refs.

Intensities of odors at their sources were studied in terms of odor pollution. Speed of odor emission was introduced to express odors quantitatively. A perceptible limit of the smell of gas in one cu ft was one odor unit. Speed of odor emission and unit odor per hour were calculated by applying the law of Weber Fechner or by analyzing odorous gas composition and determining the perceptible limit of concentration of each compound in the gas. The allowable limit of odor was studied by developing a formula in which odor was assumed to spread only to leeward, not in all directions. Distance from the emission source was also considered relative to intensity of odor. Sources of bad odors within a refinery plant and their intensities were surveyed. Several countermeasures for prevention or reduction of bad odor were reported.

34178

Gridgeman, N. T.

DESIGNS FOR MULTIPLE PAIR-COMPARISON SENSORY TESTS. Can. Inst. Food Technol. J., 3(1):25-28, 1970. 6 refs. (Presented at the International Congress of Food Science and Technology, 2nd, Warsaw, Poland, 1966.)

If the relative sensory quality -- in terms, say, of intensity or delectability of flavor or odor or texture -- of a number of different food products has to be subjectively determined, the method of paired comparison offers attractions. This is because of task simplicity; that is, the subject (the panel member) has merely to choose between two alternatives according to some agreed criterion, and he has no problems about scaling or scoring to worry about. If the number of samples is n, there is in all n(n - 1)/2 pair combinations to be made. Schemes for allocating the pairs equitably among a panel of n - 1 subjects (if n is even) or n subjects (if n is odd) are given.

34279

Araki, Takashi

MEASUREMENT AND PROBLEMS OF AIR POLLUTANTS. (Taiki osen busshitsu no sokutei to mondaiten). Text in Japanese. Preprint, Industrial Public Nuisance Council, Tokyo (Japan), 16p, 1971. 4 refs. (Presented at the Public Nuisance Symposium, 6th, Tokyo, Japan, Oct. 20-21, 1971.)

The purpose and methods of air pollutant measurement, sampling quantity, frequency, and time, various measurement methods designated by the Japanese Industrial Standards, and the method of producing a standard gas are briefly discussed. Analytical methods for sulfur oxides, nitrogen oxides, carbon monoxide, hydrocarbons, oxidants, and bad odors are explained. The electroconductivity measurement is used for detecting the total amount of sulfur dioxide and sulfur trioxide in the air, which is absorbed in hydrogen peroxide solution and measured automatically. Automatic absorption photometry is used for measuring NOx in the air, using the reaction of naphthyl ethylenediamine chlorine salt and sulphanyl acid to nitrous acid ion. However, it is not certain how much nitrogen dioxide in the solution reacts to this method. Carbon monoxide is analyzed by non-dispersion infrared analyzers. The positive filter method is explained. Gas chromatography is used for organic elements such as hydrocarbons, aldehydes, and alcohols. Gas chromatography is effective especially for analyzing various photochemical elements such as peroxyacyl nitrates. Analyses of ozone in oxidant is usually conducted by coulometry or absorption photometry. The nature of odor is complex and varied, and satisfactory measurement methods have not been developed. However, successful analyses of hydrogen sulfide or mercaptan have been reported using gas chromatography with a flame photometric detector.

34863

Mulik, J. D., R. K. Stevens, and R. Baumgardner

AN ANALYTICAL SYSTEM DESIGNED TO MEASURE MULTIPLE MALODOROUS COMPOUNDS RELATED TO KRAFT MILL ACTIVITIES. Preprint, Southern California Univ., Los Angeles, 23p., 1971. 10 refs. (Presented at the Conference on Methods in Air Pollution and Industrial Hygiene Studies, 12th, Los Angeles, Calif., April 6-8, 1971.)

Automated chromatographs with flame photometric detectors were developed for qualitative and quantitative analysis of both low- and high-molecular-weight sulfur compounds in kraft mill effluents. One chromatograph with a Teflon column packed with Teflon and coated with polyphenyl ether was used to measure the following low-molecular-weight compounds: hydrogen sulfide, sulfur dioxide, methyl mercaptan, ethyl mercaptan, and propyl mercaptan. A second chromatograph resolved the higher-molecular-weight compounds: butyl mercaptan, dimethyl disulfide, dipropyl sulfide, and dibutyl sulfide. Kraft mill effluents with sulfur species at five ppb to percent levels were analyzed with the aid of a six-stage dynamic dilution system. Principal emissions from mills employing the weak black liquor oxidation process were hydrogen sulfide and methyl mercaptan. Sulfur dioxide and hydrogen sulfide were the major pollutants from the strong black liquor oxidation process. (Author abstract modified)

34972

Kay, Robert E.

INVESTIGATION OF ANIMAL SENSOR AND SENSOR INFORMATION PROCESSING MECHANISMS FOR APPLICATION TO TARGET ACQUISTION AND TRACKING. (FINAL REPORT). Philco-Ford Corp., Newport Beach, Calif., Aeronutronic Div., Naval Air Systems Command Contract N00019-70-C-0150, Rept. U-4908, 55p., Feb. 1971. 19 refs. NTIS, DDC: AD 720412

Investigations dealing with the analyses of animal sensory and information processing systems are summarized, and two in vitro devices are described which resulted from ideas generated by these analyses. Using the receptor and fast action potentials as endpoint criteria, the effects of odor concentration and quality, temperature, mixing of odors, and duration and frequency of odor stimulus on the interaction of odors with olfactory cell membranes were examined. The potential usefulness of organic semiconductors in power producing devices has been demonstrated. Spectral sensitivity is considered as a factor in visual target acquisition by insects. The conversion of electromagnetic to electrical energy is examined, and a methyl violet 2B photocell was constructed.

35182

Gaynullina, E. T.

BIONICS AS APPLIED TO ANALYTICAL RESEARCH. Zh. Vses. Khim. Obshchestva im. D. I. Mendeleeva., 15(5):553-560, Oct. 9, 1970. 68 refs. Translated from Russian in: Atmospheric Studies at Chemical Enterprises - USSR, p. 153-169, March 9, 1971. Joint Publications Research Services, Washington, D. C. NTIS: JPRS-52566

Bionics includes such problems as simulation of the olfactory organs of animate organisms and development of methods of analyzing toxic compounds using biologically active substances such as enzymes. The enzyme method of analysis has found broad application both for indicating poisonous substances with a neuro-paralytic effect and in analyzing low concentrations of organophosphorus insecticides. Various procedures using the cholinesterase reaction are tabulated and an automatic signal for analyzing cholinesterase inhibitors is described. Instruments for measuring odors have also been developed. One is based on measuring the heat of adsorption with a semiconductor thermal resistor coated with an adsorbing film. Another instrument analyzes scent with respect to the variation of the electric current arising as a result of sorption and oxidation of the scent at a liquid-gas interface. A third analyzer operates on the principle of selective adsorption of ultraviolet radiation. The olfactory analyzers should find broad application in industrial facilities.

35240

California State Dept. of Public Health, Berkeley, Air and Industrial Hygiene Lab.

THE MEASUREMENT OF ODOR CONCENTRATION BY DYNAMIC OLFACTOMETRY. Preprint, California Air Resources Board, Sacramento and California State Dept. of Public Health, 10p., 1971. (Presented at the Conference on Methods in Air Pollution and Industrial Hygiene Studies, 12th, Los Angeles, Calif., April 6-8, 1971.)

A measurement method for the determination of odor concentration in the atmosphere or in source emissions in terms of a specific odorant is presented, in which the odor is measured at the odor threshold while the odorant is introduced to a stream of deodorized air. The dynamic olfactometer used includes a carbon vane pump, two flowmeters, two deodorizing columns, a 300-ml surge chamber, primary dilution chamber, cyclone mixing chamber, inhalation mask, and sampling probe. The range for ambient atmospheric sampling is 2-1200 dilutions and for captured gas sampling, 2-300,000 dilutions. The reliability of the measurements were determined at plus or minus 30%. Factors interfering with the olfactory perception of the observer include respirator [illegible]fections, allergic reactions, irritating noises, and elevated temperatures. Reagents, apparatus, and procedure are detailed.

35541

Dravnieks, A. and J. Whitfield

GAS CHROMATOGRAPHIC STUDY OF AIR QUALITY IN SCHOOLS. ASHRAE (Am. Soc. Heat. Refrig. Air-Cond. Eng.) Proc., vol. 77:113-123, 1971. 13 refs.

By use of high-capacity organic vapor collection devices and appropriate sample transfer analysis techniques, combined with psychophysical odor evaluation of the gas chromatically resolved components at the effluent port of a gas chromatograph, it is possible to gather considerable insight into the inventory of the odorous components of an air sample. These procedures were applied to a study of air in several Chicago metropolitan area schools. The outside air was also examined, to permit assessments of the contribution of outside air pollution to the air pollution of the school air by organic vapors and odorants. The gas chromatographic parameters were then inspected, using non-parametric statistics for correlations to the air quality which was first independently ranked using engineering data and on-the-spot observations. (Author introduction)

35648

MacKay, Donald A. M., David A. Lang, and Murray Berdick

OBJECTIVE MEASUREMENT OF ODOR: IONIZATION DETECTION OF FOOD VOLATILES. Anal. Chem., 33(10):1369-1374, Sept. 1961. 14 refs. (Presented at the American Chemical Society, Division of Agricultural and Food Chemistry, Meeting, 135th Boston, Mass., April 1959.)

Volatiles in various foods, beverages, and flavoring materials were directly analyzed with gas chromatographic ionization detectors. The sensitivity of the detectors (10 to minus the 12th power or 10 to minus the 14th power/mole) make possible the breakdown of odors into their various components. Typical chromatograms are given for vapors from peppermint oils, fresh and imitation banana, brewed and roast coffee; brandy; various whiskies; onion volatiles; and cigar and ciagarette smoke. With the ionization detection technique, direct correlation with sensory evaluation is possible. Moreover, the sensitivity of the method allows a lower temperature to be used and the concentration step to be circumvented in many cases. Instead of working with 10 to 100 ml of liquid concentrates, from one to five ml of vapor samples can be used. The techniques described are equally applicable to odor problems in perfumery and air pollution.

35751

Shigeta, Yoshihiro

METHODS OF MEASURING BAD ODOR AND CONTROL TECHNIQUE. (Akushu no sokutei-ho to boshi gijutsu). Text in Japanese. Japan Society of Efficiency, Tokyo, Chem. Plant Eng. Conf. Proc., Tokyo, Japan, 1971, p. 2-2-1 - 2-2-10. (Oct.)

Various methods used for odor sensitivity tests are examined and discussed. In general, results from the injection method were lower than those from the odorless chamber method; indices from the Shuken Kinoshita (saline-water equilibrium) method were approximately 1/100 lower than the injection method, due to the fact that many odor causing elements do not dissolve easily in water. The scentometer was also discussed. Methods of mechanical analyses included gas chromatography; the low-temperature adsorption method; the vacuum jar method; and the solid reaction tube method, using appropriate reagents for different odors.

35865

Barth, C. L. and L. B. Polkowski

IDENTIFYING ODOROUS COMPONENTS OF STORED DAIRY MANURE. Preprint, American Society of Agricultural Engineers, Saint Joseph, Mich., 27p., 1971. 27 refs. (Presented at the American Society of Agricultural Engineers, Winter Meeting, Chicago, Ill., Dec. 7-10, 1971, Paper 71-568.)

Techniques for the determination of volatile and liquid odorous components produced in stored liquid dairy manure were examined. Selective absorption, steam distillation, and paper chromatography procedures were effective in the separation, analysis, and identification of gaseous volatile organic acids, amines, ammonia, hydrogen sulfide, mercaptans, and disulfides. (Author summary modified)

35949

Grennfelt, Peringe

GAS CHROMATOGRAPHIC ANALYSIS OF GASEOUS SULFUR COMPOUNDS IN THE ATMOSPHERE. (Gaukromatografisk analys av gasformiga svavelforeningar in atmosfaren). Text in Swedish. Lakartidningen, 68(28):3232-3234, 1971. 4 refs.

Most of the volatile sulfur compounds can be detected by their smell in very low concentrations. There are, however, no methods available for the simultaneous measurement of malodorous materials in concentrations below one ppm. An instrument for the simultaneous measurement of different gaseous sulfur compounds up to a minimum concentration of approximately five ppb was reproduced and tested in Sweden. The instrument represents a special gas chromatograph with an air volume of 10 ml. The air sample is brought by a carrier gas (nitrogen) into the column where separation occurs, depending on the affinity to the gaseous phase contained in the column. The detector is a flame photometer in which the gases are burned in the presence of a hydrogen surplus. Due to a chemiluminescent reaction, the sulfur present in the flame emits light in a wavelength range of 300-423 micron. A filter is inserted between flame and phototube that only transmits the light of the wavelength of 394 + or - five micron. The selectivity for sulfur is 10,000-30,000-to-one relative to other substances. The minimum detectable concentration lies at about three ppb. The phototube delivers signals for a one microvolt recorder. This instrument has been used for practical measurements in the surroundings of three sulfate plants when organoleptic tests were carried out at the same time. A correlation factor of 0.6 was found between organolpetic and instrumental testing. The method is being further developed to make detection of concentrations below odor threshold possible.

35956

Cooper, Hal B. H., Jr. and August T. Rossano, Jr.

SOURCE TESTING FOR AIR POLLUTION CONTROL. Wilton, Conn., Environmental Research and Applications, Inc., 1971, 228p. 532 refs.

Source testing for air pollution control is reviewed with respect to basic procedures, terminology, operating and theoretical priciples, gas flow measurements, sampling trains, principles and methodology of particulate sampling, gaseous sampling, continuous monitoring, and special applications of various techniques. Measurements of stack gas parameters prior to sampling are discussed for determinations of temperature, pressure, moisture content, and gas composition using such instruments as thermometers, thermocouples, thermistors, wet or dry bulbs, condensation methods, Orsat analyzers, pitot tubes, anemometers, tracers, balloons, and various meters. Instrumentation for particulate sampling includes sampling probes, flowmeters, wet impingers, filters, centrifugal separators, and electrostatic and thermal precipitators. Particulate sampling trains are examined with respect to specific contaminants (polynuclear hydrocarbons, fluoride compounds, mists, tars, and droplets); combustion sources, e.g., boilers, incinerators, open burning, pulp and paper plants, lime kilns, kraft recovery furnaces, chemical processing, and metallurgical operations; and particle size analysis using impingers and cascade impactors. Sampling techniques for gases containing sulfur oxides, hydrogen sulfide, mercaptans, total sulfur, nitrogen oxides, ammonia, chlorine compounds, carbon monoxide, and organic gases and vapors include absorption into a liquid phase, using sample probes and impingers; collection in fabric bags; adsorption on a solid; and freeze-out techniques. Subsequent analytical methods include wet chemical analysis (turbidimetry, colorimetry, potentiometry, polarography, iodimetric methods, and Orsat analysis) and instrumental analysis (gas chromatography, spectrophotometry, flame ionization, and mass spectrometry). Special applications for the techniques include determination of odor thresholds of flue gases, measurement of acid deposition onto metal surfaces, the presence of radioactive materials, and bacterial emissions to the atmosphere. Pertinent source test data and sources of equipment are included.

D. AIR QUALITY MEASUREMENTS

00209

R. Cederlof, M. L. Edfors, L. Friberg, and T. Lindvall

DETERMINATION OF ODOR THRESHOLDS FOR FLUE GASES FROM A SWEDISH SULFATE CELLULOSE PLANT. Tappi, 48(7):405-411, July 1965. Nord. Hyg. Tidskr. Vol. 46:51-56, 1965, Danish.

The purpose of the investigation was to determine the odor thresholds of complex flue gases from two Swedish sulfate certain individual processes on the odor strength of the total measures were also studied. Odor threshold determinations were made by means of an exposure apparatus especially devised for field studies. The subjects were tested according to the principle of paired comparisons between test gases (in different dilutions) and fresh air. The odor threshold was evaluated as a value, expressing the logarithm of the dilution factor at which on the average 50% of the subjects noticed the odor. The odor strength of the flue gases from the two stacks investigated were markedly similar. Parallel chemical analysis showed a correlation between the concentration of the sulfur compounds analyzed and the odor threshold of the gases. In studying the odor reducing effect of various technical measures it was found that oxidation of the flue gases with black liquor reduced the odor threshold by approximately one power of 10 and the use oa a 'chlorine scrubber' by two powers of 10. (Authors' abstract)

00241

R.W. Hurn D.E. Seizinger

AIR POLLUTION INVENTORY - ENTER THE DIESEL. Proc. Am. Petrol. Inst., 45(111):127-132, May 1965. (Presented at the 30th Midyear Meeting, American Petroleum Inst. Div. of Refining, Montreal, Canada, May 10, 1965.)

Exhaust gases from truck-type diesel engines tested on a dynamometer stand were shown to involve hydrocarbons, oxides of nitrogen, and formaldehyde in significant quantities. Without reference to similar modes of operation, each class of pollutant was found to be generated in the diesel combustion in concentrations comparable to concentrations found in automotive (gasoline-powered) equipment. Although some trends in the data were observed, the experimental program was not extensive enough to justify conclusions regarding effects of fuels, engine design, or mode of engine operation. In comparing present findings with previously published information, the authors have noted interpretations of data that do not readily reflect the significant magnitudes of diesel emissions. Both the real contribution of diesels to air pollutant loading and the participation of these pollutants in the photochemical system should be weighed more carefully. (Authors' abstract)

00251

L. R. Reckner, W. E. Scott and W. F. Biller

THE COMPOSITION AND ODOR OF DIESEL EXHAUST. Proc. Am. Petrol. Inst. 45(111):133-147, May 1965. (Presented at the 30th Midyear Meeting, American Petroleum Inst. Division of Refining, Montreal, Canada, May 10, 1965.)

Sampling and analysis techniques are described for determining light hydrocarbons, oxides of nitrogen, formaldehyde, acrolein, total aldehydes, total particulate, and polycyclic aromatic hydrocarbons in diesel exhaust. Using the techniques described, results are reported on the composition of exhaust from two diesel engines, a two- and a four-cycle, under a variety of operating conditions. Smoke ratings using different techniques are also reported and compared to total particulate results. No correlation was found between smokemeter ratings and particulate loadings at other than black smoke conditions. Human panel observations of exhaust odor are being made as part of a continuing program, but no panel data are reported. (Authors' abstract)

00373

SUBMARINE ATMOSPHERE HABITABILITY DATA BOOK (REVISION-1). Navy Dept., Washington, D. C., Bureau of Ships (NAVSHIPS 250-649-1). Sept. 1962. 198 pp.

This publication brings together scattered information and references to more detailed information on chemical principles, experimental results, and operating experience concerned with maintenance of atmospheric habitability in nuclear-powered submarines. Habitability is defined as control of chemical aspects of the atmosphere to meet the requirements of equipment and personnel. Recommended methods for removal of carbon dioxide, carbon monoxide, hydrocarbons, aerosols, and odors are discussed. Basic operation of an electrostatic precipitator is described. Details are given on the continuous air monitoring system required to insure safe operation of the submarine.

00690

H. P. Sanderson, P. Bradt, and M. Katz

A STUDY OF AIR POLLUTION IN SAINT JOHN, NEW BRUNSWICK, CANADA. Preprint. (Presented at the 58th Annual Meeting, Air Pollution Control Association, Toronto, Canada, June 20-24, 1965, Paper No. 65-135.)

An analysis has been made of air pollution data gathered over a two-year period in the City of Saint John, N.B., which has a population of about 95,000. Apart from normal activities, this town is also the site of a large Kraft pulp and paper mill and an oil refinery. Continuous measurements of smoke concentrations with AISI paper tape samplers and more limited observations of hydrogen sulphide with lead acetate impregnated paper tape samplers were carried out at two sampling sites in each case. The study has been conducted in cooperation with the Saint John Board of Health and the Meteorological Branch, Canada Department of Transport. The soiling index values in Coh units per 1000 linear ft. show a strong seasonal trend. The soiling potential is markedly higher during the heating season than in the late spring, summer and early fall months. There is also evident a diurnal variation in pollution with a relatively high frequency of heavy concentrations occurring during the morning hours between 8 and 9:30 a.m., with a secondary peak in the evening. The observations have been correlated with wind speed and direction. A comparison has been made of these results with similar data from eight other Canadian cities. Hydrogen sulphide, as an index of the odor nuisance due to sulphur compounds, has been detected on many occasions, coincident probably with subjective reports of such occurrences or reported blackening of painted buildings. (Author abstract)

00751

S.W. Horstman, R.F. Wromble, A.N. Heller

IDENTIFICATION OF COMMUNITY ODOR PROBLEMS BY USE OF AN OBSERVER CORPS. J. Air Pollution Control Assoc. 15(6):261- 264, June 1965. (Presented at the 56th Annual Meeting, Air Pollution Control Association, Detroit, Mich., June 9-13, 1963.)

To evaluate the major odors affecting a community, approximately 120 high school students recorded odor observations. Simultaneous odor observations were made three times daily for 14 consecutive days each in a fall and spring survey. The observes were tested for olfactory sensitivity, and population characteristics were recorded for analyses of the human variables. These data were analyzed to show the areas most severely affected, the major objectionable odor types, the time when odors were most frequent, and the associated weather parameters. A critique of the procedures employed and the results of the survey is presented. (Authors' abstract)

01202

M. Nolan

A SURVEY OF AIR POLLUTION IN COMMUNITIES AROUND THE JOHN F. KENNEDY INTERNATIONAL AIRPORT (Sept. - Oct. 1964). Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. June 1966. 82 pp. GPO,HEW: 826-792-2

A 1-month air-quality study was conducted in the communities adjacent to John F. Kennedy Airport in Queens and Nassau Counties, New York, from September 24 to October 24, 1964. Eight sampling stations were located in the area. Limited measurements of particulate matter and hydrocarbons, and odor observations yielded some evidence to indicate that aircraft operations contributed a small amount to particulate and hydrocarbon concentrations and to odor occurrence. Concentrations of particulates, odors, and hydrocarbons at the sampling stations were substantial and came from many sources in the metropolitan area. Thus, the small variations that occurred in measured air quality were not significantly correlated to aircraft emissions on a statistical basis. The number and percentage of jet aircraft using water injection during takeoff decreased markedly from 1963 to 1964 at the J. F. Kennedy Airport; therefore, smoke emissions caused by water injection have been reduced. This downward trend is expected to continue. Meteorological conditions during the study were near normal for this period of the year. Poor conditions for atmospheric dispersion were experienced for a 5-day period; however, no prolonged severe atmospheric stagnation occurred. Therefore, air contaminant concentrations that would exist under extremely adverse meteorological conditions could not be measured. The limited, modest studies did not show any difference in the characteristics of particulates emitted from jet, diesel, or gasoline engines.

01949

P. W. Hildebrand and R. L. Stockman

AIR QUALITY IN CLARK COUNTY, WASHINGTON. Washington State Dept. of Health, Olympia, Division of Environmental Health. 74 PP.

This is a report on a community air pollution survey which began Feb. 1, 1961 and which was conducted in cooperation with the Clark County Air Pollution Committee and the Clark-Skamania Health District. The following findings, and conclusions, are given. Clark County air pollution problems are primarily restricted to localized areas in the immediate vicinity of specific sources. Existing nuisance conditions and the potential for an area-wide problem in the near future warrant corrective and preventive action on the part of the community. Air pollution concentrations in Portland, Oregon are demonstrably higher than those measured in Clark County leading to the conclusion that area-wide pollution in the County will increase as community development progresses. Air pollution effects that can be established include fallout of solid materials, odor, soiling and esthetic considerations. Heating and transportation make significant contributions to the total problem. Gaseous emissions and concentrations have not been studied sufficiently to establish their effects upon the community. Local legislation is presently inadequate to control the problem on either a corrective or preventive basis This report recommends that an air pollution control district, as provided for by the laws of the State of Washington, be established encompassing Clark County and the cities of Vancouver and Camas.

02212

M.E. McLouth H.J. Paulus

AIR POLLUTION FROM THE GRAIN INDUSTRY. J. Air Pollution Control Assoc., 11, 313-7, July 1961, (Presented at the 53rd Annual Meeting, Air Pollution Control Association, Cincinnati, Ohio, May 22-26, 1960.

In the Twin Cities, the many elevators, mills, and plants of the grain industry comprise a substantial portion of the industrial picture. Millions of bushels of grain are processed into human and animal foods and other products each year in plants scattered throughtout the area. The air contaminants from the grain industry operations consist of various sizes and types of particles from grain handling operations and certain odor producing compounds from linseed and soybean oil processing and refining, animal food fproduction, and other processes. Grain unloading and loading, considered to be the dustiest operations, are carried on by essentially all types of mills and plants. Grain dust collected at the mills is utilized in animal food preparations after being prepared in dust grinding mill. Handling of the collected dust and dust grinding to destroy weed seeds are extremely dusty operations that contribute substantial amounts of pollution to the atmosphere. Most of the dusty operations are exhaust ventilated through collection systems. Cyclone separators are the most commonly used collectors with baghouse filter installations gaining in prominence in recent years. For special situations in grain operations electro-static precipitators and multicyclones are being used. Preliminary results of a study on the dispersion of dust from the grain industry plants indicate a considerable influence on the total particulate pollution in limited area. (Author summary)

02331

H. N. Jenkins and T. O. Harris.

INTERSTATE AIR POLLUTION STUDY. PHASE II PROJECT REPORT IV. ODORS - RESULTS OF SURVEYS. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution pp. 53, June 1966.

The odor episode experienced during the survey was caused by odors that originated in Illinois, crossed the Mississippi River, and extended all the way west across St. Louis and into St. Louis County almost to the St. Louis Municipal Airport.

This episode clearly indicated that severe interstate odor problems do exist in the metropolitan area. Further indication of the existence of interstate and interjurisdictional odor problems is presented which strongly indicates that the chemical odors so frequently observed in St. Louis arise from the industrial complexes on the Illinois side of the Mississippi River. The results of the survey described indicate that unpleasant odors are of relatively frequent occurrence in the St. Louis Metropolitan Area. The existence of these odors is a source of considerable discomfort to the multitude of persons forced to breathe this contaminated air during the course of their everyday activities. Future increases in population and industrialization will surely cause the odor situation to become even more undesirable if steps are not taken to alleviate present conditions and prevent the occurrence of future odor problems. Tables, graphs and appendices are given. (Author summary)

02339

THE AIR POLLUTION SITUATION IN TERRE HAUTE, INDIANA WITH SPECIAL REFERENCE TO THE HYDROGEN SULFIDE INCIDENT OF MAY-JUNE, 1964. Public Health Service, Washington, D.C., Division of Air Pollution and Indiana Air Pollution Control Board, Division of Sanitary Engineering. June 19, 1964. 28 pp.

Concentrations of hydrogen sulfide in Terre Haute during the episodes of late May and early June 1964 were sufficient to cause public complaints and discomfort and paint blackening. Concentrations exceeding 30 parts per hundred million (pphm) were measured. The most probably source of hydrogen sulfide and other odorous materials which caused the public complaints and discomfort and paint darkening was a 36-acre lagoon used for the biodegradation of organic industrial wastes. This was indicated by the relationship between measurements of hydrogen sulfide and odor observations and meteorological data and also by measurements of hydrogen sulfide made in the immediate vicinity of suspect sources. There are sources of other pollutants in Terre Haute such as smoke and flyash which should be controlled. Many public complaints about odors, health effects and property damage were made by citizens of Terre Haute during the current episodes. Investigation of the possible health effects of the air pollution revealed the presence of an air pollution problem with greater than nuisance value. The main symptoms reported by affected people included nausea, loss of sleep and abrupt awakening, shortness of breath and headache. However, almost none sought medical attention. In the opinion of medical observers, the hydrogen sulfide and other obnoxious odorous materials were the likely cause of certain symptoms in exposed individuals. A 'medical disaster' did not occur. There was a pressing need for the establishment of an adequate air pollution control program in Terre Haute. (Author conclusions modified)

03001

THE AUCKLAND AIR POLLUTION RESEARCH COMMITTEE (SEVENTH ANNUAL REPT. FOR YEAR ENDING MAR. 31, 1966.) Auckland Air Pollution Research Committee, New Zealand. 33 pp., 1966

The conclusion of the fourth annual survey in Auckland, New Zealand, is that no significant increases in air pollution have occurred in the last year. The specific areas of consideration are: (1) smoke levels, (2) odors, and (3) pollution by motor vehicles. The report reflects an increased awareness by the public of the air pollution problem and is exemplified by the adoption of smoke regulations.

03017

P. A. Kenline

IN QUEST OF CLEAN AIR FOR BERLIN, NEW HAMPSHIRE. Public Health Service, Cincinnati, Ohio, Division of Air Pollution (Technical Rept. No. A62-9) 53 pp., 1962

The city of Berlin, with a population of 15,000 is a manufacturing area. Manufacturing accounts for over half of all employment, with 1 plant accounting for 80% of this toal. The population has been gradually decreasing since 1930. The city proper occupies 4 square miles and is situated in a valley such that frequent inversions, confinement of lateral dispersion, and weak winds allow periods of pollutant accumulation. Levels of suspended particulate matter (averaging 183 ug./cu m) and dustfall (35 tons/sq. miles/30 days) are relatively high, compared to levels measured in other areas. Levels of sulfur dioxide (averaging 16 ppb.), hydrogen sulfide (max. 23 ppb.), and malodors, although not generally or consistently high, do not reach levels where undesirable effects are produced. Pollution was heaviest in areas near the pulp mill and tended to carry down the valley. Air pollution problems exist in Berlin and have reached levels that justify constructive efforts to ameliorate the situation. It was concluded from the study that emissions from other than industrial operations are not of sufficient magnitude to warrant consideration of control measures. Since all of the 9 initial steps to achieve control op pollutionnrelated to Brown Co., it was suggested that the Berlin City Council request the Company to undertake the 1st 7 items and report their findings to the Council. The last 2 items require only diligence on the part of the Company with regard to operation and good housekeeping.

03418

E. V. Porter

AN ODOR SURVEY OF THE TWO KANSAS CITYS. Public Health Service, Washington, D.C.Div of Air Pollution. (In cooperation with Kansas City, Kans. and Kansas City, Mo.) July 1965. 39 pp.

A survey with special attention given to the central industrial areas was conducted for a 2-week period during the first part of December 1963. The purpose of the study was to determine the type and general level of the odor problem of these areas. The major sources were stockyard districts, yransportation and smoke. Meteorological data are provided and recommendations are made.

03431

G. B. Welsh.

AN APPRAISAL OF AIR POLLUTION IN HUNTSVILLE, ALABAMA. Public Health Service, Washington, D.C., Div. of Air Pollution. May 1963. GPO: 862-747

During the period 1950 to 1963, the population of Huntsville increased about 480%. This growth trend, which is expected to continue, favors higher pollution levels in the future unless adequate control measures are taken. Local meteorological factors tend to intensify the air pollution problem in Huntsville. During periods of adverse meteorological conditions air pollutants may be concentrated in the business district of the city. The southeastern portion of the United States, which inlcudes Huntsville, is subjected to a high frequency of low-level atmospheric temperature inversions and stagnating air masses. Both of these conditions contribute to accumulation of air pollution in Huntsville, especially during the months of the year when the space heating requirements are greatest. The atmospheric pollutants of primary concern is Huntsville are due to (1) the improper combustion of coal, (and oil to a lesser degree) for space heating and power generation in connection with residential, commercial and industrial usages; (2) burning of garbage and refuse at the dump and of refuse on the premises of commercial and industrial installations; and (3) dust from mineral processing activities. Pollutants of secondary concern are odors, gases, and solvent vapors from various industrial and commercial activities. In addition, emissions from motor vehicles should also be considered. Whule public complaints have been primarily directed at smoke and dust problems there are many other gaseous pollutants which add to the complexity and magnitude of the proboelm. Periodic incidents of reduced visibility are one apparent indication of air pollution problem in Huntsville. Measurements of air pollution that have been made to data are inadequate to define the nature and extent of the air pollution problem. Visual observations indicate that the primary problems probably are: (1) smoke from the improper combustion of certain fuels and burning garbage and refuse; and (2) dusts from the processing and production of building materials. There is no organized air pollution control effort in Huntsville at the present time. The zoning ordinance establishes specific uses for certain districts and provides performance standards for air pollution control in the Research Park District. If properly enforced the zoning ordinance should minimize the future intermingling of residential and industrial areas, a condition that usually intensifies local air pollution problems.

03459

P. A. Kenline

AIR POLLUTION IN HAMILTON, OHIO. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. 1960, 19 pp. (Rept. No. A60-8.) HEW: A60-8

The purpose of this appraisal was to determine the status of the air pollution situation and the need for activity on the part of government in solving air pollution problems. This report is an analysis of data and information assembled on air pollution levels, sources, dispersion, and local control activity. Industrial sources of pollutants contribute significantly to Hamilton's air pollution levels. These sources include emissions which are of principal concern to a localized area near the source, and emissions which contribute to the overall community pollution level. Examples of industrial emissions include odors from several sources, dust from a slag and gravel products plant, and emissions from a chemical plant, cupolas, foundries, and various fabricated metal products producers. (Author summary modified)

03506

P. A. Kenline

AIR POLLUTION IN CHARLESTON, SOUTH CAROLINA. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. (Rept. A60-6.) 1960. 32 pp. HEW: A60-6

At the request of the South Carolina Department of Health and with the cooperation of the Charleston County Health Department, the Public Health Service made an appraisal of factors relating to air pollution in the Charleston area. The purpose of this appraisal was to determine the status of the air pollution situation, and the need for government activity in solving air pollution problems. This report is an analysis of information collected relating to sources of pollutants, dispersion of pollutants, indication of pollution levels, and the status of local activity in the air pollution field. Charleston lies in an area of frequent stagnating high pressure systems - the meteorological model associated with major air pollution episodes - and for this reason bears surveillance. However, because of its proximity to the Atlantic Ocean and its level topography, Charleston usually receives good ventilation in part because of the sea breeze. This advantageous phenomenon decreases inland. The atmospheric pollutants of immediate concern derive from industrial sources. However, domestic, commercial, and municipal sources do contribute to the overall pollution load of the atmosphere. To date, public complaints relate to nuisances, particularly industrial odors. There have also been a few allegations of vegetation and property damage. Measurements by the Public Health Service's National Air Sampling Network in the City of Charleston indicate that the particulate loading is not excessive, as judged by comparison with cities of comparable size. The sampler is located in the center of the city and is not indicative of pollution levels in other areas. Of greatest interest and concern is the North Charleston 'neck' which contains within a limited area a complex of air pollutant sources and residences. No data are available to indicate pollution levels in this area, although analysis of the Network data implies that they are significantly higher than in the city. There is presently no local or State air pollution program, nor is there routinely available to the local area any agency with authority and competence in this field. On the basis of this appraisal and the general available knowledge relating to air pollution, the following recommendations are made to the Charleston County Health Department. (1) Information should be developed relating in detail to air pollution levels and sources in the Charleston area, particularly to the north of the city limits. (2) A modest public education program should be undertaken. (3) A modest air pollution program should be developed within the County Health Department. (4) In

03514

ATMOSPHERIC POLLUTION IN THE GREAT KANAWHA RIVER VALLEY INDUSTRIAL AREA. West Virginia State Dept. of Health, Charleston, Bureau of Industrial Hygiene and Cincinnati Univ., Ohio, Kettering Lab. 1952. 184 pp.

The purpose of the survey was to (1) establish factual information as to the atmospheric pollution problem of the valley, (2) compare the present particle-fall load of the valley to that of a previous survey made by the Bureau of Industrial Hygiene, West Virginia Department of Health from June 1945 to December 1947 and (3) to determine the present or future needs of establishing an agressive air pollution control program for the area. The total daily load of particulate solid matter discharged to the atmosphere was found to be approximately 500 tons, derived mostly from burning or processing of coal; that of gases, fumes, and vapors, most of which are sulfur gases from the use of coal, amounted to about 370 tons. While the particulate matter (fly ash, etc.) can be controlled to acceptable levels through selection of coal and installation of collectors, it does not appear that there is any prospect of 'cleaning up' the valley completely, although there is evidence that much more can be accomplished by economical means. It is further indicated that even with a consistent uniform daily loading of the atmosphere with particulate matter, the ground level concentrations may vary greatly, depending upon meteorological conditions. The elimination of sulfur dioxide arising from the use of coal is an extremely difficult problem, since low sulfur coal is not obtainable locally in sufficient quantity, while chemical methods of control would be economically prohibitive at the present time. Odors, which are extremely annoying at times, have not been explained satisfactorily in many cases. Analytical methods of identification are not available except in a few cases, although special equipment might be valuable in identifying such contaminants. Greater assistance from industry is required to identify such materials, to determine their toxicity and to establish the quantities discharged into the atmosphere. Two episodes of eye irritation of fairly severe character occurred in 1951. While these were of short duration, they served to indicate that pollution in the valley, under adverse conditions, can cause demonstrable ill effects. (Author summary modified)

05256

V. A. Ryazanov

CRITERIA AND METHODS OF ESTABLISHING THE MAXIMUM PERMISSIBLE CONCENTRATIONS OF ATMOSPHERE POLLUTION IN THE USSR. (In: maximum permissible concentrations of atmospheric pollution.) Predel'no Dopustimyye Kontsentratii Atmosfernykh Zagryazneniy. Academy of Medical Sciences USSR. (8), 5-21 (1964). Russ. (Tr)

Four different opinions may be found in the literature on approaches to the establishedment of maximum permissible concentrations of atmosphere pollution. They may be briefly formulated in the following way: (1) Only that composition of the air that is observed under natural conditions in noncontaminated human environment can be recognized as normal; (2) Only that content of a given contaminant in the atmospheric air that cannot practically be removed at the modern level of development of technology should be considered as normal. (3) Only such concentrations as are economically justified should be considered the standard, i. e. the cost of measures guaranteeing their achievement should be equal or less than the cost of the damage that they inflict upon society; and (4) Only such concentration of atmosphere pollution as does not exert either a direct or an indirect toxic or unpleasant action on man, does not reduce his ability to work, and exerts no negative influence on his health and frame of mind can be recognized as permissible. In the USSR two types of indices of degree of contamination of the atmospheric air are used: maximum permissible single and average daily concentrations. They are aimed at preventing the chronic resorptive action of toxic substances during prolonged inhalation. The maximum single permissible concentrations are aimed at preventing atmosphere pollution that might produce reflex reactions through irritation of the receptors of the respiratory organs, chiefly the olfactory region of the nasal cavity. Summarizing, it can be noted that the Russians attribute great significance in the substantiation of the maximum permissible concentrations of atmosphere pollution to experimental methods of investigation.

05481

AMBIENT AIR: GUILFORD COUNTY, NORTH CAROLINA. Guilford County Health Dept., Greenboro, N.C., Division of Environmental Health. 1966. 52 pp.

The purpose of this report was to provide factual information for the citizens and government of Guilford County for use in the development of a program to control air quality in the area. The County covers an area of 691 sq. miles and has a population of 246,520 (1960 census statistics). Industrial activities include: textile, wood products, machinery and metal products, food products, mineral products, printing and publishing, paint, chemical and fertilizer manufacturing. Pollutants resulting from these activities include: dusts, fines, fumes, smokes, organic vapors, odors, and gases. Sampling data for the year between 1964 and 1966 were obtained by the following methods: high volume samplers for suspended particles, dustfall jar sampling for dusts, AISI tapes for soiling index measurements, and gas samplers for SO2, NO and NO2. The sampling data are tabulated for the various pollutants. Estimated fuel usage in the County for the year of 1965 is tabulated. Estimated sulfur content for coal was 0.9% and 1.0% for commercial and domestic use, and industrial use, respectively. Meteorological aspects here pertaining to air pollution are also reported. Results indicated that an undesirable concentration of air pollution existed, based on levels established in other sections of the nation. More detailed and concentrated efforts are needed on gaseous sampling for achieving meaningful conclusions.

06535

T. O. Carver, B. Bucove, V. G. Mackenzie, and A. N. Heller

AN APPROACH TO A SOLUTION OF AN INTERSTATE AIR POLLUTION PROBLEM. Preprint. (Presented at the 57th Annual Meeting, Air Pollution Control Association, Houston, Tex., June 1964.)

A six-months study (1961-1962) of an air pollution problem in Lewiston, Idaho and Clarkston, Washington was made jointly by the Departments of Health of Idaho and Washington and the Division of Air Pollution, Public Health Service. Aerometric studies, meteorological conditions, materials damage, and emission inventories were evaluated and preliminary considerations of health effects were made. Socio-economic aspects via a public awareness study of air pollution in Clarkston, Washington are reviewed in terms of survey methodology and analysis. Complementary studies of an odor survey in both Lewiston and Clarkston are interpreted. The development of a number of joint recommendations to solve the immediate air resource management problem and allow for future economic growth in the valley is explored. (Authors' abstract)

07572

Benforado, D. M. and G. Cooper

THE APPLICATION OF DIRECT-FLAME INCINERATION AS AN ODOR CONTROL PROCESS IN KRAFT PULP MILLS. Preprint, (19)p., (1968). 18 refs. (Presented at the 22nd Engineering Conference, Process Systems & Controls Water & Air Pollution, TAPPI, Atlanta, Ga., Sept. 19-22, 1967.)

A method of controlling the odors in Kraft Pulp Mills by direct-flame incineration is discussed. The design criteria, as well as the incorporation of heat recovery equipment, is covered. A method of quantitatively measuring the odor strength of waste gases and the use of this method to determine effectiveness of control equipment is also discussed. The intent of the paper is to offer one method of air pollution control which appears to be applicable to Kraft Pulp Mills and which may be equated with other methods presently being considered. (Authors' abstract)

09590

Public Health Service, Washington, D. C., National Center for Air Pollution Control

PARKERSBURG, WEST VIRGINIA, MARIETTA, OHIO AIR POLLUTION ABATEMENT ACTIVITY. 87p., March 1967. ((38)) refs.

An investigation of air pollution in the interstate area encompassing Mariette, Ohio, Parkersburg, West Virginia, and Vienna, West Virginia was conducted. The average concentrations of suspended particulates measured in the three major population centers was in excess of 150 micrograms per cubic meter with maximum daily values in excess of 500 micrograms per cubic meter. The average value for 2-hour sulfur dioxide measurements made at three locations was approximately 0.02 part per million parts of air. At the Vienna station, however, a daily average concentration of 0.10 part of sulfur dioxide per million parts of air was exceeded 3.4 percent of the time.

Short-term concentrations approached one part sulfur dioxide per million parts of air at various times. Sensitive vegetation exposed in Vienna developed injury that was attributed to the synergistic action of ozone and sulfur dioxide in low-level combination. Damage to indigenous vegetation from sulfur dioxide and fluorides was also observed. Atmospheric corrosion of ferrous metals was not abnormally high. Tarnishing of silver plate indicated, however, that the presence of gaseous sulfides is consistent with reported complaints of odor nuisance. From an inventory of emissions of sulfur oxides and particulate pollutants it is estimated that more than 123,000,000 pounds of sulfur oxides and 25,000,000 pounds of particulate pollutants are emitted each year from sources in the survey area. Approximately 85 percent of the sulfur oxide and 55 percent of the particulate matter are emitted from sources in Ohio, and 15 percent of the sulfur oxides and 45 percent of the particulate matter from sources in West Virginia. Eight point sources account for almost 98 percent of the total sulfur oxides and 94 percent of total particulate emissions. Mathematical applications of diffusion theory were used to estimate the relative contributions of specific sources.

09592

Public Health Service, Washington, D. C., National Center for Air Pollution Control

LEWISTON, IDAHO, CLARKSTON, WASHINGTON AIR POLLUTION ABATEMENT ACTIVITY. 61p., Feb. 1967. 18 refs.

Investigations of air pollution in the community have been concerned with air quality, meteorology, sources of pollutants, and various effects of air pollution. There are numerous sources of air pollution in the community; the largest of these is a kraft pulp mill located just east of Lewiston. Other sources include: Lumbering Operations; Asphalt Mix Plants; Food Processing Plants; Concrete Mixing and Grain Handling; Fuel Usage; Refuse Disposal; and Vehicular Emissions. The interstate movement of pollutants, particularly odorous gases emitted by the pulp mill in Idaho and transported to Clarkston, Wash., has been demonstrated. In a public opinion survey in Clarkston, Wash., more than 90 percent of the persons interviewed perceived air pollution in the community as a malador problem. The pulp mill reported emissions amounting to about 1,800 pounds of hydrogen sulfide, 2,500 pounds of mercaptans, and 1,000 pounds of organic sulfide gases per day; about 23,000 pounds of particulates, consisting mostly of sodium sulfate and sodium carbonate per day, from the mill's recovery furnaces; and an average of about 9,700 tons of water vapor per day from all operations. Calculated daily emissions of selected pollutants from sources other than the pulp mill included about 4,000 pounds of particulates, 100,000 pounds of carbon monoxide, and more than 20,000 pounds of hydrocarbons. About two-thirds of the community emissions are released in Idaho and about one-third in Washington. The valley topography of the Lewiston-Clarkston area results in the transport of air pollutants alternately from either of the states to the other.

12426

Vaughan, H. L. and G. B. Welsh

AIR POLLUTION EVALUATION. PASCAGOULA - MOSS POINT AREA OF MISSISSIPPI. Jackson County Health Dept., Miss., 15p., Feb. 1964 5 refs.

A thirty day air pollution evaluation was undertaken in the Pascagoula-Moss Point area to determine the extent and magnitude of the air pollution problem and to obtain basic information on air pollution levels that may be useful as a reference point to indicate any significant changes that may occur in the future. The Pascagoula-Moss Point area is one of the most industrialized areas in Mississippi and has the potential for future industrial expansion. The air pollutant levels indicated that air pollution is not a serious problem at present, although hydrogen sulfide levels may be sufficient to cause lead base paint discoloration and odor complaints at times; the suspended particulate loading indicated a potential problem. It was pointed out that a short term evaluation can only provide a general indication of air pollution levels. Generally, the meteorological conditions in the Pascagoula-Moss Point area favor the dispersion and dilution of air pollution. However, periodic low-level inversions and stagnant air masses may occur. There are also indications that appreciable periods of calm-stagnant weather may occur which contributes to the accumulation of air pollution in the area. It was recommended that surveillance be maintained to indicate any significant changes in the air pollution problems of the area; that records of air pollution type complaints be maintained; and future evaluations be undertaken whenever there is an indication that the air pollution problem in the area may be significantly changed. (Author summary modified)

12648

S. F. Galeano

HOW TO DEVELOP AIR SURVEILLANCE PROGRAMS FOR PULP MILLS. Paper Trade J., 153(1):41-43, Jan. 6, 1969. 2 Refs.

Air quality and emission standards are being prepared and implemented by local and state authorities on a continuing basis. Emissions to the atmosphere by pulp and paper mills, as well as other industrial plants, will be governed by these standards. The most meaningful contribution of a paper mill air surveillance program would be in providing data essential to the establishment of realistic air quality standards. With such a program supported by management, a company will be in a position to authoritatively recommend realistic air criteria for the area surrounding a particular manufacturing facility. A substantive surveillance program is outlined.

16062

Donkelaar Van, A.

AIR QUALITY CONTROL IN A BLEACHED KRAFT MILL. Can. Pulp Paper Assn., Tech. Sec., p. T346-T350, 1967 (?). 10 refs. (Presented at Paper Ind. Air and Stream Improvement Conf., 3rd, Vancouver, B. C., 1967.)

The air pollution control program of a bleached kraft mill in northern Calif. is described. By using black liquor oxidation, hydrogen sulfide emissions from the stack were reduced to near zero, and a high degree of efficiency in eliminating mercaptans and organic sulfides was reached through treatment by incineration. A detailed in-plant monitoring program for measuring emissions is described and the results reported weekly to the local Air Pollution Control District. The use of telephone responses and home monitoring systems are also valuable. Four-hour checks on critical equipment, weather measurements, and an ambient air monitoring program in which particulate fall-out is measured at seven stations, are also part of the control program. Data show typical main stack emissions, lime kiln stack emissions, and green liquor dissolver stack emissions.

16635

Gil'denskjol'd, R. S.

EXPERIMENTAL BASIS FOR THE DETERMINATION OF MAXIMAL ALLOWABLE SINGLE CARBON BISULFIDE CONCENTRATION IN ATMOSPHERIC AIR. U.S.S. Literature on Air Pollution and Related Occupational Diseases, vol.8:153-158, 1963. (B. S. Levine, ed.) CFSTI: 63-11570

Atmospheric air pollution with carbon disulfide discharged from a combine was studied. Air samples were collected within radii of 150, 500, 1000, 1500, 2000, 2500, and 3000 m from the combine. A total of 342 samples were collected on the lee side of the plant. Results showed that carbon disulfide vapor was detected 3000 m from the plant. Carbon disulfide odor was detected 2000 m from the plant. Sensory tests indicated that 0.05 mg/cu m of carbon disulfide was the threshold concentration sensed by most odor- sensitive persons. Optical chronaxy tests indicated that 0.04 mg/cu m of CS2 was the threshold concentration of carbon disulfide reflex activity affect. Statistical analysis showed that 0.04 mg/cu m CS2 was the minimal active concentration which elicited shifts in darkness adapted eye sensitivity to light, and that 0.03 mg/cu m was the maximum subthreshold concentration. It was concluded that the existing 0.5 mg/cu m maximal single and 0.15 mg/cu m average 24-hr CS2 concentrations were too high. The presently recommended and adopted 0.03 mg/cu m limit of allowable carbon disulfide concentration in atmospheric air of inhabited localities is below the threshold of odor perception and reflex activity affect.

16636

Baikov, B. K.

HYGIENIC DATA RELATED TO SANITARY CLEARANCE ZONES FOR KORKINSK OPEN COAL PITS. U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 8:188-190, 1963. (B. S. Levine, ed.) CFSTI: 63-11570

The degree of air pollution with coal dust, sulfur dioxide, and carbon monoxide at different distances from the Korkinsk open coal pits was investigated. Air samples were collected on the lee side of the mine pit at 300, 500, 800, 1000, and 1200 m from the pits. Air samples for the determination of SO2 were collected by the aspiration method and determined nephelometrically, using a gas analyzer. Records were kept of the temperature, air humidity, wind direction and velocity, and barometric pressure. Results showed intense pollution with SO2 and dust. Sulfur dioxide concentrations exceeded the limit of allowable single concentration for atmospheric air of inhabited places by 260% at 300 m, and by 100% at 800 m. Dust concentrations exceeded the hygienic norm by 360% at 300 m and by 140% at 800 m. Carbon monoxide was present in trace amounts only. Residents in the vicinity complained of unpleasant odor and air dustiness. A sanitary clearance zone of 1000 m was recommended. The sanitary clearance zone could be reduced where sufficient hydro-mechanical installations are efficiently operated, provided that production processes and sanitary-hygienic protection means are under strict inspection and control.

17630

Kogo, Tetsutaro, Ryosaku Endo, Tatsunori Oyake, and
Hiroshi Shirakawa

OFFENSIVE ODORS. 9. INVESTIGATION OF THE EXISTING CONDITIONS IN HOKKAIDO WITH RESPECT TO OFFENSIVE ODORS (FIRST REPORT). INVESTIGATION OF THE ORIGINS OF THE ODORS, THE DAMAGE BEING CAUSED, AND THE REACTIONS AND ATTITUDES OF THE LOCAL RESIDENTS. Taiki Os Kenkyu (J. Japan Soc. Air Pollution), 2(1):48-58, 1967. Translated from Japanese. 4p.

Out of 1586 cases of complaints and petitions concerning public hazards received by the Hokkaido local government in 1965, those related to offensive odors accounted for 25.6%. An investigation of the situation was conducted. The sources of odor included marine products processing plants, animal stockyards, paper manufacturing factories, garbage and trash disposal facilities, agricultural products processing plants, and animal carcass disposal facilities. An investigation of odor diffusion was conducted at 23 different offensive odor sites. Twenty-four measuring points were set up on concentric circles of radius 500, 200, 100, and 50 m, with the plant being the center. The measurements were made with the sense of smell. At distances of more than 100 m, the number of appraisals of 'no odor' was greatest, then 'faint odor', 'definite odor', 'very strong odor', and 'unbearable odor', in that order. Occurrence rates of 'definite odor' were highest downwind of the source, and the odor extended to a greater distance. Questionnaires were distributed to residents of the area, and inquiries were made concerning their reactions and attitudes toward the odor. A total of 70.9% of all the people interviewed appraised the odor to be 'definite odor' or greater.

18231

Turk, Amos, Janet T. Wittes, L. R. Reckner, and R. E.
Squires

SENSORY EVALUATION OF DIESEL EXHAUST ODORS. Public Health Service, Raleigh, N. C., National Air Pollution Control Administration, Contracts PH 27-66-96 and CPA-69-528, 67p., February 1970. CFSTI: PB 192 224, NAPCA: AP-60

Exhaust gases, not necessarily toxic, emitted by diesel engines, are characterized by offensive odors which can be rated numerically by human judges. Correlations of such ratings with the chemical composition of diesel exhaust will aid in establishing Federal standards for diesel exhaust emissions and developing methods of diesel odor control. An outline is presented for the development of programs in which human panelists selected for superior olfactory ability can be trained to rate odors in terms of quality and intensity relative to reference standards. These techniques are being applied in much of the PHS-sponsored research involving air pollution by diesel engines. Further work undertaken to develop and extend earlier studies is summarized. Described is the physical arrangement of an exhaust dilution and panel exposure system designed to simulate on-the-street exposure to emissions. Instructions for conducting the odor evaluation tests with these facilities are also presented, along with the design of test programs and statistical analysis of the resulting test data. Appendices describe the theoretical basis for air purification requirements in test chambers, the composition and makeup of diesel odor standards, and mathematical derivations of the statistical procedures. (Author abstract modified)

20355

Murata, M., H. Hirobe, H. Shima, T. Kanamaru, T. Matsui,
and K. Naka

AIR POLLUTION IN YOKKAICHI CITY. (Yokkaichi no taiki osen: gasujo osen busshitsu (ryukaiwo) ni tsuite.) Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 4(1):5, 1969. (Proceedings of the 10th Annual Meeting of the Japan Society of Air Pollution, 1969.)

The citizens of Yokkaichi have complained extensively about obnoxious odors. Organic sulfur compounds and hydrogen sulfide emitted or leaking out from the local petrochemical industry were suspected of being the main cause, and an investigation on hydrogen sulfide was conducted. The observations were made around the industrial locations of the city during the winter of 1968 - 1969. Instantaneous measurement by means of milli-pore filter method was mainly employed. The concentration of hydrogen sulfide in the air around Yokkaichi was below 20 ppb, the odor threshold for hydrogen sulfide. However, if the rotten egg odor did originate in hydrogen sulfide, there probably was an operational mistake or emission from the factories.

23098

Hoshika, Yasuyuki

SOME EXAMPLES OF INVESTIGATING ODOR POLLUTION. PART II. (Akushu kogaichosa no nisan no jirei. tsuzuki). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(2):19-23, June 20, 1970. 27 refs.

The data from the experimental field survey of the odor problem in three areas adjacent to two chemical plants and a drug plant are analyzed. The items included in the questionnaire were subjective olfactory perception, weather conditions, subjective symptoms of health injury from the odor, opinion of existing odor problem and similar questions. Due to geographical features, odor bearing emission gas in one area, was observed to form atmospheric odor layers flowing over hilly suburbs and covering the whole area as far as 2 km away. In another area, odor level was found almost same as in the past. A comparison of the data with the results derived from the field measurement of odor by an olfactorium and gas chromatography was attempted to determine the correlation between the olfactory perception thresholds and the quantitative data from odor measurement devices. Odorous emission from the chemical plants was measured to be 10 million cu m/hr and nearly 10 billion cu m/hr from the drug plant as was initially expected, the odor intensity index obtained by the olfaction test and the odor intensity multiple of threshold value detected by the meters were not necessarily the same. By constructing a table that shows the relationship between organoleptic and mechanical measurement results, it might be possible to infer as to whether the odor components complement or neutralize each other, whether other odor components not detectable by measurement devices exist, or whether there are other background odors in the general area.

23149

Nose, Yoshikatsu and Yoshio Katagawa

ON THE UNEXPECTED AIR POLLUTION AND THE CONSIDERATION OF THE CAUSE. PART II. EPIDEMIOLOGICAL RESEARCH ON THE ODOR IN TOKUYAMA CITY. (Toppatsuteki taiki osen to sono geninteki kosatsu. sono 2. Tokuyama-shi ni okeru shuki no ekigaku teki tsuikyu). Text in Japanese. Yamaguchi Idai Sangyo Igaku Kenkyusho Nenpo (Ann. Report Res. Inst. Ind. Med., Yamaguchi Med. School), no. 16:225-227, 1969. 1 ref.

In Tokuyama, a town of petrochemical industry, frequent odors have been the target of citizens' complaints. The geographical distribution of complaint frequencies determined by means of a questionnaire survey and wind speed and direction indicated that the odors originate from the eastern industrial complex. Despite the claim by industry representatives that the odors were the result of the secondary reaction of gases similar to photo-chemical events, the meteorological data showed that the odors were the result of direct emissions from the factories. Some of the most frequent descriptions of the odor are, indescribable, headaches, loss of appetite, eye irritations, nausea, sore throat, burning sulfur, and human waste. The geographical distribution of these descriptions indicated that the odorants consisted of butadiene, styrene, ethylene, hydrogen sulfide, and similar substances. The investigation results pointed to the factory of the N-rubber Co. and the odor was determined as butadiene and styrene. The odor problem was subsequently voluntarily rectified by the company. 23149 Nose, Yoshikatsu and Yoshio Katagawa

23152

Nose, Yoshikatsu and Sekio Ueno

ON THE UNEXPECTED AIR POLLUTION AND THE CONSIDERATION OF THE CAUSE. PART I. EPIDEMIOLOGICAL RESEARCH ON THE IRRITATING GASES IN NANYO-CHO. (Toppatsuteki taiki osen to sono geninteki kosatsu. Sono 1. Nanyo-cho ni oleru shigekisei gasu no ekigakuteki tsuikyu) Text in Japanese. Yamaguchi Idai Sangyo Igaku Kenkyusho Nenpo (Ann. Report Res. Inst. Ind. Med., Yamaguchi Med. School), no. 16:221-224, 1969. 1 ref.

Residents living close to the coastal petrochemical industry complex in Nanyo, Yamaguchi, have been complaining of occasional severe eye irritations. The residents were asked to fill out questionnaires and six persons were requested to be confidential monitors. The analysis of complaint frequencies, the geographical distributions of complaints, and wind speed and direction led to the conclusion that the eastern industrial complex could be excluded. The compilation of the types of physical perceptions, (eye irritation, sweet-sour smell) and the geographical distribution of the frequency of complaints indicated that the obnoxious gas originated periodically from the western complex. Contrary to the claim by the industrial representatives that the pollution is a secondary or indirect result of photochemical effect in the atmosphere, the data revealed that the emissions were directly from the factories. The reports from the monitors further confirmed that the odors probably consist of halogens, aldehydes, halogen compounds of hydrocarbons, acetic acid, or ethylene. The responsible factories subsequently voluntarily eliminated the emissions.

23411

Alkire, H. L. and John Bramblett

AIR POLLUTION IN WASHINGTON COUNTY MARYLAND. Maryland State Department of Health, Baltimore, Div. of Air Quality Control and Washington County Dept. of Health, 63p., Jan. 1970. 20 refs.

The study was conducted to provide a preliminary survey of air pollution conditions. It is part of a series of county surveys which are being prepared for Maryland. The report is based on measurement of atmospheric pollutants for several years in Hagerstown and on data in the files of the State and county health departments. The measurements of suspended particulate matter indicate that the annual arithmetic average value in some 30 micrograms/cu m higher than the serious level standard of 75 micrograms/cu m and 40 above the adverse level of 65. Some 24 hour readings exceed 160 micrograms/cu m. Measurements of dustfall indicate that the serious level standard of 14 tons/sq mi/mo and the adverse level of 10, is exceeded. Readings in Hagerstown have averaged 18.3 tons/sq mi/mo over a nine-year period. In regard to sulfur dioxide concentrations in the ambient air, a serious level standard of 0.03 ppm and an adverse level of 0.015 ppm (annual arithmetic average) have been proposed. Actual readings were slightly above the serious concentration at 0.031 ppm. The pollution problems are mainly associated with a variety of manufacturing processes, the combustion of coal and oil, and odors from plants using organic chemicals. The increased fuel use for space heating in the winter is closely allied with higher levels of sulfur dioxide and the soiling index. Dust from quarrying operations at four rural locations creates nuisances in the immediate vicinity of these facilities. Smudge pots which are used to lessen the chances of frost damage to fruit blossoms near Hancock and in the northeastern portion of the county create extremely dirty conditions. The use of insecticides by the orchard industry also creates objectionable odors in those areas. There are two burning dumps, one near Hagerstown rated the fifth worst dump in the State. In the Williamsport area a power plant is responsible for locally heavy emission concentrations and a brick yard and tannery are responsible for other undersirable emissions. With the exception of Hagerstown, Williamsport, and Hancock, Washington County has satisfactorily clean air. There are infrequent cases of stagnation and pollution drift that may temporarily raise pollutant levels in other parts of the county.

23845

Cholark, J., L. J. Schafer, and R. F. Hoffer

RESULTS OF A FIVE-YEAR INVESTIGATION OF AIR POLLUTION IN CINCINNATI. Arch. Ind. Hyg. Occupational Med., Vol. 6:314-325, 1952. 3 refs. (Presented at the American Industrial Hygiene Association, Air Pollution Division, Annual Meeting, 13th, Cincinnati, Ohio, April 24, 1952.)

The results of an air quality investigation in Cincinnati, Ohio are presented. Samples were taken at 18 sites, several times monthly for a period of five years. At each of the stations, samples of suspended matter were collected by an electrostatic precipitator and were analyzed several ways to determine the composition of the particulate matter suspended in the atmosphere. Compounds identified included various metals, sulfur dioxide, fluorides, chlorides, carbon monoxide, carbon dioxide, aldehydes, nitrates, and ammonia. In addition, measurements of odors and dust fall are reported. Relationships between pollutant concentration and traffic density, season, and meteorological conditions are discussed. Plans for the continuation of the monitoring network are described.

24162

Thom, Norman G.

AIR POLLUTION FROM MOTOR VEHICLES IN NEW ZEALAND. SAE-Australasia, 30(4):136-142, July-Aug. 1970. 6 refs. (Presented at the Vehicle Exhaust Symposium, Auckland, New Zealand, April 15, 1970.)

Air pollution monitoring in New Zealand, particularly in Auckland, has indicated that levels of pollution originating from motor vehicles are comparable with those of similar sized cities in developed countries. Carbon monoxide affects the body by combining with the hemoglobin of the blood to form carboxyhemoglobin, thus decreasing the ability of the blood to carry oxygen to body cells. The maximum two hour concentration measured in Auckland would result in approximately 3% of a person's hemoglobin being combined with CO if he were a non-smoker and stayed in the area where the measurements were taken for two hours. The major significance of the oxides of nitrogen in air pollution is the role they play in the formation of photochemical smog. Average 24 hour concentrations in Auckland range from 0.4 pphm in the outer suburbs to 9.0 pphm in the city streets. Hydrocarbons no doubt include many of the gases which give rise to traffic odors, while some of the ring shaped compounds are known carcinogens. The main significance of the hydrocarbons emitted in the exhaust gases is that they contain many unsaturated compounds which are very reactive in the processes which give rise to photochemical smog. However, Auckland has neither the topography nor meteorology likely for promoting this type of phenomenon. Values of airborne lead range from peak concentrations of 6.0 micrograms/cu m in city streets to an average 0.6 micrograms/cu m in residential areas Lead is to some degree a cumulative poison in the human body. Generally, a well maintained diesel that is not overloaded gives rise to less air pollution than an equivalent gasoline vehicle. Control of air pollution from automobiles is also mentioned.

25291

Osaka Municipal Office, (Japan)

THE PRESENT STATUS AND THE CONTROL OF PUBLI NUISANCES IN OSAKA. (Osaka-shi no kogai no genkyo to sono taisaku). Text in Japanese. Public Nuisance Control Material NO. '70-12, 124p., July 1970.

General statistics related to the city of Osaka are enumerated initially. The items concerning air pollution cover the transition of air pollution such as the historical data on the quantity of settling dusts, sulfur oxides, and the number of smoggy days. Also covered under the present status of air pollution are the quantity of settling dusts, the sulfur oxides concentration according to the lead peroxide as well as electroconductivity methods, the concentration of suspended particulates, and air pollution monitoring stations. The background and the present status of automobile exhaust pollution are also included. The control measures against air pollution consist of regulation by laws, enlightenment and administrative guidance, smog alert and emergency measures, constant surveillance, control of automobile emissions, investigation of pollution effects, and the execution of plans to establish air pollution environmental standards. The report further discusses water pollution, noise pollution, ground settling, bad odors, industrial wastes, aid to pollution victims, special loan funds for pollution control equipment purchases, and appropriate geographical distribution of factories.

25780

Public Health Service, Durham, N. C., National Air Pollution Control Administration

PARKERSBURG, WEST VIRGINIA–MARIETTA, OHIO, AIR POLLUTION ABATEMENT ACTIVITY: SUPPLEMENTAL TECHNICAL REPORT. NAPCA Pub. APTD 69-50, 71p., Sept. 1969. 31 refs. NTIS: PB 195144

To supplement and update a 1967 technical report on air abatement activity in the Parkersburg, West Virginia - Marietta, Ohio area, a number of field investigations were initiated in January 1969 and continued through August 1969. The activities included additional measurements of sulfur dioxide pollution through saturation samplin using sulfation plate measurements and aerial sampling from light aircraft. Data developed by these tests were used to determine the spread of sulfur dioxide over the area and the transport and diffusion of sulfur dioxide emissions from large sources. Source categories surveyed in 1966 were re-examined to determine whether significant changes had occurred in type and quantity of pollutant emissions in the two-year period since the initial survey. The general condition of vegetation in the area, particularly in the vicinity of major pollutant sources, was surveyed to determine the extent of injury from air pollution and possible changes in types of injury and areas affected since 1967. An odor and irritant survey was performed to obtain evidence of odors and sensory irritants causing lachrymation or nasal and throat discomfort. The results of the survey efforts are reported, and recommendations made with regard to control of process and steam-generating-plant emissions and refuse disposal.

25996

National Air Pollution Control Administration, Raleigh, N. C. and West Virginia Air Pollution Control Commission

KANAWHA VALLEY AIR POLLUTION STUDY. NAPCA Pub-APTD-70-1, 369p., March 1970. 96 refs. NTIS: PB 194881

A cooperative study of air pollution in the upper Kanawha Valley of West Virginia was undertaken. Air quality measurements were made, meteorological parameters were evaluted, odor studies were undertaken, and existing information was collected and evaluated. A pollutant emission inventory was compiled from fuel combustion sources, refuse disposal, gasoline and solvent evaporation losses, chemical processes, concrete batch plants, metallurgical processes, wood products, and a number of other industrial processes. Wind data, sunshine, temperature and stability, and climatology are discussed. Measurements of particulate matter, sulfur dioxide, carbon monoxide, oxidants, nitrogen dioxide, hydrogen sulfide, sulfuric acid mist, and total aldehydes are included. The relationship between air quality and emissions is mentioned. Air quality goals and reduction plans are discussed. Materials deterioration is evaluated and control economics are considered. Instruments for measurements are also listed.

26304

Nishida, Konosuke, Yoshinori Ishikawa, Takashi Suzuki, Masaichi Sasaki, Junichi Ueda, Kazutomo Yamaguchi, and Sadaharu Hattori

A TENTATIVE PLAN CONCERNING A COMPREHENSIVE ASSESSMENT OF ENVIRONMENTAL POLLUTION. (Kankyo osen no sogo hyoka ni kansuru ichi shian). Text in Japanese. Koshu Eisei (Public Health), 34(9):563-572, Sept. 1970. 17 refs.

A tentative plan, for assessing factors which adversely affect the environment of Kyoto city involved dividing it into 404 evaluating zones and measuring environmental contaminants in each area to assess the level of pollution. The measured values were classified into 5 grades for each of 7 contaminant factors (noise, sulfur oxides, nitrogen oxides, carbon monoxide, bad odor density 5 soot and dust, and the density of factories) which seemed to adversely affect the situation, and an assessment was correspondingly made for each grade. Questionnaires distributed to citizens were analyzed; the weighting coefficients which reflected the various degrees of influence of the seven contaminant factors on the living conditions in each zone were calculated. A comprehensive, overall value was computed by multiplying the measured levels of contaminants by their respective weighting coefficients and by summing up seven measured points in each zone. The comprehensive values derived in this way were further classifie into 5 grades, and assessments which corresponded with each grade were given. The quantitative degree of contamination for each zone were plotted on a map of Kyoto city giving an overall distribution of pollution. As a result, the living conditions were shown to have deteriorated most seriously in 3 sections of Nishijin Kamigyo-ku and the whole of Kawaramachi, and Nakagyo-ku; 5 areas of Minami-ku and the east of Sakyo-ku; and 2 areas of north of Fujimi-ku. The conditions were best in the western parts of Kita-ku, Sakyo-ku, and Ukyo-ku and the southwest of Fushimi-ku. Compared with the distribution of areas where environmental pollution complaints arise, the map giving the overall assessments for Kyoto city shows that the former are generally located where conditions have deteriorated. The comparison reveals a generally close correspondence between the areas where complaints arise and those worst affected according to the comprehensive, overall grading.

27255

Miyaga Prefecture (Japan), Dept. of Hygiene

AIR POLLUTION. (Taikiosen). Text in Japanese. In: Data of Environmental Pollution in Miyagi Prefecture. Report 7. (April 1969 - March 1970). (Miyagiken Kogai Shiryo. Dai 7 ho. (Showa 44 nen 4 gatsu - Showa 45 nen 3 gatsu)). Sendai, Japan, Miyagi Prefecture, Sept. 1970, Chapt. II, p. 4-100.

The results of measuring dust fall, sulfur oxides, automobile exhaust gases, and offensive odor substances, of meteorological observations, investigations of the effects of offensive odors on the human body, and a previous inquiry for prevention of environmental pollution arising from industries at Sendai Bay district of the new industrial city in Miyagi Prefecture from January to December 1969 are reported. The yearly amount of dust fall and the concentrations of sulfur oxides (by the PbO2 method) were 61 (6.39 t/sq km/month) and 80 (0.34 mg/100 sq cm/day), respectively in the case of taking the 1965 values as 100. The observation of dust fall by season revealed that the amount was the lowest in summer and had increased gradually from autumn to winter. The average concentrations of sulfur oxides measured by the electric conductivity method were within a range of 0.007 to 0.011 ppm. Among meteorological observations, the average wind speed at Sendai and Taga district were 2.1 - 3.1 and 2.3 - 3.5 m/s respectively. The results of measurement of automobile exhaust gases at Furukawa and Ishinomaki revealed that the average annual values of carbon monoxide were 11.5 ppm and 9.4 ppm, and those of nitrogen dioxide were 4.8 pphm and 5.1 pphm, respectively; they were high during rush hours in the morning and the evening. A diffusion experiment was previously conducted by an air-tracer system; at the same time, local meteorological conditions were observed. Ophthalmologic and nasopharyngeal examinations, lung function tests, examinations of blood pressure and urine, and roentgenographic examinations were carried out, based on the result of a consciousness survey to offensive odor and individual questioning including questionnaires about subjective symptoms at Shiogama where there were fish-meal factories. Offensive odor occurred on rainy days and rainy seasons.

29349

Nakayama, Hidero

REPORT OF THE INVESTIGATIONS ON THE OFFENSIVE ODOR IN YOKKAICHI CITY. (Yokkaichi chiku ni okeru akushu ni kansuru chosa hokokusho). Text in Japanese. 122p., 1969.

Offensive odors in Yokkaichi City, Mie Prefecture were analyzed. The concentration was estimated and gas chromatographic qualitative and quantitative determinations were made. The selection of column, conditions of gas chromatography, drawing up of a calibration curve, and the method of elimination were mentioned. On-the-spot investigations were carried out in the district around the petroleum industries in the town and the site of frequent complaints from March 1969 to March 1970. Although the charts had not yet determined some patterns, they showed that hydrocarbons were frequently found because of the petroleum industry s use of substances with relatively low boiling points. Furthermore, the sulfur compounds such as hydrogen sulfide, carbon disulfide and methyl mercaptan were detected in some districts and aldehydes such acetaldehyde and n-butyraldehyde at other districts. Hydrocarbons include many olefins. Also, the relationship between the contamination by organic matters and the amount of hydrogen sulfide and total aldehyde was observed; 0.026 ppm H2S was detected at one point and aldehydes were found at every point, with a minimal value of 0.003 ppm and a maximum of

0.022 ppm. This result agreed with the result from gas chromatography. The amount of bad-smelling substances such as mercaptan and sulfinel could not be determined when they coexisted with a great deal of hydrocarbons and other substances.

29973

Tokyo Metropolitan Environmental Protection Research Inst. (Japan)

POLLUTIONS AND TOKYO METROPOLITAN GOVERNMENT. (Kogai to Tokyo-to). Text in Japanese. 724p., June 1970.

Ten thousand and four hundred facilities are required to report under Air Pollution Control Law, of which 91% are boilers. In the six central wards, there are 37% of the total boilers, considered to be for heating of buildings. There are only 17 open hearths, 84 cupolas, 61 electric furnaces for steel-making, 25 boilers for thermal generation, and 45 facilities to supply city gas. Of the 19 stacks taller than 70 m, 13 are in Kawasaki City, and nine are in Yokohama; these 41 stacks emit 6,783.3 cu m sulfur dioxide. Pollutants emitted in a year in Tokyo are: 857,000 tons of carbon monoxide, 444,000 tons of SO2, and 30,000 tons of particulates. This is roughly twice as much SO2 and CO as in the U. S. Metals and sulfuric acid mist adhere to dust. Also the 10 micron and submicron particulates from electric furnace can be seen only under electronic microscopes. At a busy intersection in Tokyo, 11.6 ppm CO on the ground was measured, the daily average was 11.6 ppm and 12.3 ppm at another crossing. Nitric oxide concentration in front of the Metropolitan Government Office was 0.078 ppm, annual average, but in the hinterland, the concentration of nitrogen dioxide was greater. The number of cars has increased at the rate of 100,000 a year since 1960, and at 200,000 since 1966; recently there is one car for every 6.5 people. Most of CO is estimated to have been caused by the automobiles gasoline combustion. Cars emit NO at high concentrations near the ground. Also, 270 complaints out of 1000 complaints on air pollution lodged with the Metropolitan Government in 1960 concerned the factories which generated harmful substance and obnoxious odor. Of 12,000 factories, employing more than 20 workers, about 5000 are suspected of emitting harmful gas and obnoxious odor. Since 1964, manuals on guiding these enterprises have been in use on dust, harmful substance (ammonia and chromium acid mist), and there are 14 in all as of March, 1969. Thirteen automatic measuring equipment stations have been installed to measure SO2 and micro- particulates (rate of filtering) and six stations measure CO, NO, and NO2 (to be increased to nine in the future). At present, five spots on major highways measure CO, NO, NO2, and hydrocarbons (to be increased to 10 spots in 1969 and 1970). Air pollution control agreements have been concluded between the Tokyo Metropolitan Government, the Tokyo Electric Power Co., and the Tokyo Gas Co.

31371

Japan Environmental Sanitation Center, Tokyo

REPORT OF A SURVEY ON ENVIRONMENTAL QUALITY IN THE DISTRICTS UNDER POLLUTION CONTROL PROGRAM. (Kogai boshi keikaku sakutei chiiki kankyo chosa hokokusho). Text in Japanese. 136p., March 1969.

Air pollution, water pollution, offensive odors, and noise in the Chiba/Ichihara, Yokkaichi, and Mizushima districts were surveyed in 1968. Average daily sulfur dioxide concentrations were 0.02 ppm in the Chiba/Ichihara district and 0.01-0.05 ppm in the Yokkaichi district. Values measured at 28 points in the latter district varied according to direction, wind velocity, and geographical conditions. The mean value of suspended dusts in the Chiba/Ichihara district was 151.6 microgram/cu m, but values as high as 256-1649 microgram/cu m were measured in Yokkaichi. Here iron contents of 105.8 microgram/cu m and 334.0 microgram/cu m were found. Organic sulfur compounds such as dimethyl sulfide (1.0 ppb) and isoprophyl mercaptan (3.5 ppb) were also detected in Yokkaichi City. Nitrogen oxides and hydrogen chloride values in th Chiba/Ichihara district were 0.003-0.025 ppm and 0.01-0.06 ppm, respectively. Fluorine compounds were not detected. Maximum chlorine, formaldehyde, and hydrogen sulfide concentrations of 0.07, 0.057, and 0.005 ppm, respectively, were measured in the summer. In the Mizushima district, two methods were applied to determine offensive odors from petroleum complexes: odorimetry and gas chromatography. With the latter measuring 0.006-0.012 ppm of ethyl acetate. The gas was irritative with a sour and sweet odor. Biological oxygen demand measurements and analysis of bottom soil in Yokkaichi harbor, and 0.20-1.28 milligram/dry kg of mercury in bottom soil of the drainage at a chemical factory in the Mizushima district. Noise levels in residential areas were below or only a little higher than the standard, but noise levels along heavily travelled roads were significantly high.

31760

Anderson, D. M., R. S. Brief, J. Churchill, J. R. Davis, P. A. Drinker, Jr., L. B. Hall, E. K. Harris, M. M. Harris, R. I. Larsen, E. H. Markee, F. Pooler, A. T. Rossano, N. E. Schell, J. J. Schueneman, P. Skaliy, J. Walters, C. A. Weishampel, and C. E. Zimmer

THE LOUISVILLE AIR POLLUTION STUDY. Robert A. Taft Sanitary Engineering Center, Cincinnati, Ohio, Jefferson County Air Pollution Control Board; Louisville and Jefferson County Board of Health; Kentucky State Dept. of Health, TR-A61-4, 172p., 1961. 88 refs.

The primary objectives of the air pollution study in Louisville, Ky. were to prepare an inventory of air pollutants emitted to the atmosphere with special regard to major sources, to determine the range of influence of pollutants arising in western Louisville, to evaluate the effect of pollutants on residents and the effect of pollution on materials, to obtain a detailed analysis of contaminants in the atmosphere, and to determine the bacterial content of the air over Louisville. An inventory of pollutant emission was made by source sampling and analysis and estimations based on existing emission information, combined with a knowledge of process throughputs, fuel consumption, and similar data. Meteorological studies on the wind, temperature, humidity, precipitation, and solar radiation were conducted. Air quality studies included collection of suspended particulate matter by a high volume sampler, dust fall measurements, gas sampling for the presence of acetylene, aldehydes, chloride, nitrogen dioxide, total oxidant, ozone, phenol, and sulfur dioxide. Bacteriological studies, odor threshold determination, and a metal deterioration study were conducted. Results of the studies and recommendations were presented.

33108

Fuji City Citizens Committee for Environmental Pollution Control (Japan)

REPORT OF THE SURVEY ON PUBLIC NUISANCE IN FUJI AREA (1). (Fuji chiiki kogai chosasho, dai 1-pen). Text in Japanese. 88p., Sept. 1969.

Pollution in the Fuji industrial area includes detailed data on climatic characteristics, the mechanism and the state of air pollution in the area centered around Motoyoshihara Junior

High School, comparison with Yokkaichi city, bad odor and noise, sources of odor emission, a survey of respiratory diseases in the area, results of questionnaires, water pollution of the sea and rivers, influence of pollution on plants and agricultural produce, and the state of pollution in the neighboring Fujikawa township. Fuji Municipal Motoyoshihara Junior High School is located in the most polluted area in the entire Fuji industrial complex; situated on a sand dune near the shore of Suruga Bay, it is flanked by four large plants on the west and 10 on the north. The sulfur dioxide counts go up characteristically with north-northwest winds; with 5 m/sec winds, it can go above 0.1 ppm. The average SO2 count from five months in 1968 was 0.093 ppm. The pollution sources include Kraft pulp mills, cellophane plants, chemical factories, Tagonoura port dredgers, aluminum electrolysis plants, fertilizer plants, and automobile exhaust gas. In the neighboring Kanbara township, there is also a light metal company. Pollutants are soot and other particulates (lime, mirabillite), sulfur dioxide, hydrogen sulfide and other sulfides, hydrogen fluoride, chlorine gas and chlorides, nitrogen compounds, and dusts. According to the investigation in April 1968, the total heavy oil consumption in Fuji city was 2,240 kl/day; black liquor, 2,750 kl/day; coal, 23 t/day; coke, 5 t/day; and wood, 16 t/day. The calculated total sulfur dioxide emissions was 130 t/day from heavy oil and 49 t/day from black liquor. According to an investigation by the Fuji Medical Association between Nov. 1967 and Oct. 1968, bronchitis and asthma cases in the polluted areas were 2.5 times as many as those in nonpolluted areas, and cases of asthmatic bronchitis in the former were four times as many as those in the latter. The ratio of asthmatic children in polluted and nonpolluted areas was 37:18; the number of absences, 131:27; and average absence per child, 3.63:1.49.

33539

Bogen, Norma, Steven Fosburg, and Gail Howrigan

ST LOUIS REGION STUDY – PART I. In: Computer Mapping as an Aid in Air Pollution Studies. Volume Two: Individual Reports. Harvard Univ., Cambridge, Mass., Lab. for Computer Graphics and Spatial Analysis, National Air Pollution Control Administration Demonstration Grant 68A-2405D, Rept. A, 72p., April 1970. 8 refs.

The Interstate Air Pollution Study was undertaken as a result of independent requests from official groups in St. Louis, Missouri, and East St. Louis, Illinois, for aid in solving odor problems and in drafting air pollution ordinances. An emission inventory was conducted. Aldehydes, carbon monoxide, hydrocarbons, nitrogen oxides, sulfur oxides, particulates, and benzo(a)pyrene were included in the survey, as well as chemical by-products. Sources of air pollution were divided into the following categories: fuel combustion in stationary plants; combustion of refuse material; fuel combustion in transportation vehicles; industrial process emissions; and solvent evaporation. Since the development of an effective air resource management program begins with identification of the pollutants in the air and determination of the quantity and origin of each type, an air quality measurement program was designed and operated in the metropolitan St. Louis area. Detailed records of air pollution complaints were compiled and summarized from local agency files. Odor surveys were carried out. Topography and meteorological parameters were considered, as well as an air pollution climatology. Recommendations were made for an air resource management program. The St. Louis Project of the Air Pollution Demonstration Study focused on levels of pollution, demographic and housing characteristics, and the relationships among these variables. Specific objectives were to map levels of air pollution, to describe the socio-economic structure of the area in spatial terms, and to relate levels of pollution to demographic characteristics. A computer mapping program was employed, with regression analysis to determine the statistical relationships among the variables.

33723

Yokkaichi Municipal Office (Japan), Div. of Public Nuisance

ACTUAL CONDITION AND COUNTERMEASURE OF ENVIRONMENTAL HAZARD IN YOKKAICHI CITY. (Yokkaichi-shi ni okeru kogai no genkyo to taisaku). Text in Japanese. 13p., June 1970.

The state of air pollution in Yokkaichi City is reviewed with respect to historical background, geographical factors basic characteristics, i.e., contamination of limited areas near factories, climatic conditions, and control measures. The major pollutants were sulfur oxides and offensive odors caused by hydrogen sulfide, mercaptan, and waste gases from oil refinery and petro-chemical industries. Seasonal winds influenced damage due to pollution, and contamination in high concentrations was determined in a broad area under a set of specific climatic conditions. A recent decrease in the concentration pollutants was due to diffusion and dilution and the use of low sulfur fuel. Monthly average values for dust fall in 1968 were 10.9 tons/sq km, which increased to more than 20 tons/sq km in the summer for regions including certain urban districts, affected by certain conditions of wind direction. Complaints of inhabitants about pollution related to offensive odor decreased from 72% in 1965 to 54% in 1969. Actual conditions of water pollution, noise, and vibration are summarized. Regulations monitoring, medical measure, and control plans for pollution prevention based on the laws for pollution control are examined. Countermeasures enforced for 1955 - 1969 and a list of factories related to the petroleum complexes are included.

35764

PUBLIC NUISANCE WHITE PAPER, 1971. (Kogai hakusho, Showa 46 nendo ban). Text in Japanese. 483p., July 10, 1971.

The state of air pollution in Japan is surveyed with respect to statistical data on concentrations of sulfur oxides, carbon monoxide, nitrogen oxides, suspended and settling particulates, and specific toxic materials (hydrogen fluorides and hydrogen cyanides). Local conditions are discussed with emphasis on areas with complex and acute air pollution problems, such as the Tokyo-Yokohama and Osaka-Amagasaki areas; specific industrial developments, e.g., Fuji, South Nagoya, Yokkaichi, North Kyushu, and Omuta; and areas where pollution is rapidly increasing due to the development of large-scale industrial complexes, such as Tomakomai, Kashima, Chiba-Ichihara-Kimizu, Mizushima, and Oita. Damages caused by air pollution and effects on human health and agricultural and forestry produce are discussed. Governmental means of control, the nation-wide network of pollutant measuring devices, and local and regional surveillance systems are reviewed. The policy on desulfurization and acquistion of low-sulfur fuels is outlined. Indirect control measures included a buffer-green area development plan, large-scale heating-cooling systems instead of individual home or building systems, and construction of collective high stacks. The offensive odor control bill is summarized.

E. ATMOSPHERIC INTERACTION

14906

Lesnik, G. E.

CERTAIN RESULTS OF INVESTIGATIONS OF ATMOSPHERIC SURFACE LAYER TURBULENCE. Tr. Gl. Geofiz. Observ. (Leningrad), no. 205:194-197 1967. Translated from Russian. Foreign Technology Div., Wright-Patterson AFB, Ohio. Translation Div., 6p., Nov. 15, 1968. CFSTI, DDC: AD 684 025

At the Koltushi weather station, observations of the structure of turbulent flows were conducted simultaneously with gradient and actionometric observations. The purpose of this work was to obtain structural and special characteristics of turbulence in the surface layer of the atmosphere and to test to new equipment for measuring the pulsation of wind speed. The equipment consisted of thermocouples and acoustic anemometers, which permitted the simultaneous recordings of three random processes: pulsations of temperature, and longitudinal and vertical components of wind speed. Measurements were taken four to six times a day for two months and at hours corresponding to the most stationary state of the surface layer. Contact anemometers measured wind speed at heights from 0.25 to 8.6 m. Experimental data is given on dispersion and time of averaging for wind speed and temperatures, correlation, structural, and spectral characteristics of turbulence over a wide interval of scales. The balance of energy of turbulence is also examined.

19849

Stephens, E. R.

THE ROLE OF OXIDES OF NITROGEN IN PHOTOCHEMICAL SMOG. Scott Research Labs., Inc., San Bernardino, Calif., 28p., June 16, 1963. 42 refs.

Chemical reactions in the atmosphere initiated by sunlight produce many of the noxious properties of smog. Formaldehyde, peroxyacyl nitrates, and acrolein, which are known to be formed in this photochemical reaction, are eye irritants. The aerosol produced by irradiating automobile exhaust has been related to the presence of sulfur dioxide. During the photolytic reaction, SO2 is oxidized to sulfuric acid which condenses to form a light scattering aerosol. Other effects of smog are plant damage, and the odor and rubber cracking due to ozone. Active components emitted to the atmosphere are nitric oxide and hydrocarbons with some participation by SO2. The first effect is the rapid conversion of NO to NO2, the rate depending on the amount and reactivity of the hydrocarbon present. With sufficient hydrocarbon, the conversion is complete, and the NO2 concentration passes through a maximum and ozone appears. Peroxyacyl nitrate is formed by reaction of peroxyacyl radicals with NO2. In the complete absence of reactive hydrocarbon the NO is only slowly converted to NO2, and NO2 decreases when photolyzed by sunlight. With 80% of the hydrocarbon removed, it seems probable that the conversion of NO would not be complete. This will have an effect on oxone concentration, since NO and ozone cannot co-exist in the same atmosphere. The decrease in peroxyacyl nitrate and aerosol should also be proportional to the decrease in hydrocarbon, since their formation is inhibited by NO. Several recommendations for further understanding of photochemical smog formation are included.

22335

Hales, Jeremy M., James O. Wilkes, and J. Louis York

THE RATE OF REACTION BETWEEN DILUTE HYDROGEN SULFIDE AND OZONE IN AIR. Atmos. Environ. (London), 3(6):657-667, Nov. 1969. 6 refs.

Gas-phase oxidation by ozone is believed to be an important factor in the removal of atmospheric hydrogen sulfide. In additon, this reaction is thought to be significant in some odor control processes involving hydrogen sulfide and organic sulfur compounds. Since little is known about the mechanism of the reaction, experimental data on the rate of reaction between dilute hydrogen sulfide and ozone in air were obtained from two tabular, laminar-flow reactors. Internal diameters of the reactors were 3/8 in. and 1/4-in. Production of sulfur dioxide by the reaction between hydrogen sulfide and ozone was measured at 28.5 C and 48 C. Results from the reactors at 28 C, when computed as homogeneous reaction rates, fell on the same curve within the limits of experimental error. From this it is concluded that the observed data represented an almost totally homogeneous reaction. Linear regression performed on the results at 28 C showed the reaction orders to be 0.495 and 1.562 in hydrogen sulfide and ozone, respectively. On the basis of the total results, an expression was derived for the rate of generation of sulfur dioxide by the reaction of hydrogen with ozone in the absence of light, the expression also representing the rate of depletion of hydrogen sulfide and ozone. From the results of previous authors, the expression H2S + 03 to yield SO2 + H2O is thought to represent the true stoichiometry adequately under the experimental conditions of the study.

26550

S[illegible]rt, W.

POLLUTION PROBLEMS FROM COMBUSTION PROCESSES. Environ. Health, 78(11):510-517, 550, Nov. 1970. 35 refs.

The essential problems with the combustion of any fuel or waste material include the nuisance due to dust, smell or particles while awaiting incineration, smoke due to poor combustion, grit and dust emission from the chimney, emission of toxic or offensive gases fro the chimney, and disposal of the residue which may contain offensiv or dangerous material. Smoke formation, furnace residues, and the storing of fuels are mentioned. Recommended chimney heights and plume behavior are also discussed. When calculating maximum concentrations of solids and sulfur dioxide, the formula used is fo an instantaneous value as might be obtained over a short period of say 3 minutes when all variables, especially wind speed and direction, are fixed at constant values. While the Clean Air Act does not lay down any figures for permissible dust and grit content in the flue gases leaving the chimneys of a boiler plant, various organizations have made suggestions covering a range of about 0.2 t 0.3 grains per cu ft of gases. However, the size distribution is important. Grit and dust deposition and measurement are discussed, and it is suggested to state the emission as weight emitted in an hour, rather than just weight and volume. Sutton's diffusion equation is cited, while factors affecting a thermal plume include the temperature of gases, their velocity and mass, and the stack height.

The incineration of chlorinated compounds and some special wastes, such as organic tars, is also mentioned.

F. BASIC SCIENCE AND TECHNOLOGY

01784

D.F. Adams, R.K. Koppe, W.N. Tuttle

ANALYSIS OF KRAFT-MILL, SULFUR-CONTAINING GASES WITH GLC IONIZAION. J. Air Pollution Control Assoc. 15, (1) 31-3, Jan. 1965

The technique includes the use of two chromatographic columns in series to separate O2, N2,CO,CO2, H2O, H2S, SO2, and CH3SH. Column 1, containing Triton 45 on Chromosorb, separates H2O, H2S, SO2 and CH2SH. Column 2, packed with Molecular Sieve, separates O2, N2, CO2. The conditions required to obtain adequate sensitivity and separation are discussed. (Author abstract)

03173

W. R. Roderick

CURRENT IDEAS ON THE CHEMICAL BASIS OF OLFACTION. J. Chem. Educ. 43, (10) 510-20, Oct. 1966.

For a compound to have an odor, it must be volatile so that its molecules are absorbed on the olfactory receptors. There is no simple relation of odor to molecular structure, since odor is a property of the entire molecule. Rather, odor appears to be determined by molecular shape and size, which are in turn determined by molecular structure. The Moncrieff-Amoore theory, based on this concept, offers the best rationalization at the present of the relation of odor to structure. The slow development of a theory of olfaction is the result of several unique problems. For one of these problems, the difficulty of unreliable data due to insufficient purity of substances, the solution is now available, and a selection of representative compounds should be purified by GLC and re-evaluated for odor. The lack of objective methods for measuring the strength and quality of odors remains the greatest problem in the study of odor. (Author summary conclusions)

07681

Fontijn, Arthur and Daniel E. Rosner

NO + O CHEMILUMINESCENT REACTION USING ADIABATICALLY EXPANDED NITRIC OXIDE. Virginia Univ., Charlottesville, Dept. of No. NR-0-,,Technical Rept. No. AC-6-P, 7p., Jan. 1967. 18 refs. CFSTI, DDC: AD 647978

The rate constant for the chemiluminescent reaction NO + O yields NO2 + hv has recently been observed from upper-atmospheric chemical releases and simulated releases in a low-density wind tunnel to be several orders of magnitude higher for adiabatically expanded than for 'normal' NO. In this note, it is shown that this enhancement can be attributed to the presence of clustered NO based on super saturation calculations and recent mass spectrometric gas-sampling data. These clusters allow the normal three-body excitation step to be replaced by a two-body step for which the observed rate constant is shown to be quite reasonable. (Authors' abstract, modified)

10308

Robert K. Koppe, and Donald F. Adams

GAS-PHASE CHLORINATION OF KRAFT PULP MILL GASES. TAPPI, 51(5) 193-195, May 1968. 12 refs.

Gas-phase chlorination of gases from kraft pulp mills appears to be of limited value as a means of odor reduction. In laboratory experiments, gas samples from the recovery furnace, batch digester, multiple-effect evaporator, and lime kiln of a mill were charged with known volumes of chlorine gas and the reactions were recorded by gas chromatography. The chlorine oxidized the methyl mercaptan in the gases to dimethyl disulfide but did not change the concentrations of hydrogen sulfide or dimethyl sulfide in the samples. Complete elimination of the methyl mercaptan apparently is possible if adequate chlorine doses are added. However, the odor reduction effected in the total gaseous effluent would probably not be sufficient to justify use of this process on a plant scale. (Authors' Abstract

11132

Tagaki, Sadayuki F.

NEUROPHYSIOLOGICAL STUDIES ON THE OLFACTORY RECEPTIVE MECHANISM (FINAL REPORT). Gunma Univ., Maebashi, Gunman-ken, (Japan), Grant DA-CRD-AFE-S92-544-67-G67, Proj. DF-9777, Task 01-004FE J-271-3, (19)p., Arpil 1968. CFSTI, DDC: AD 671678

In the previous experiment of the first year, the ionic mechanism of the negative slow potential elicited by odors in the olfactory epithelium (EOG) was negative EOGs are generated by the entry of Na ions and the exit of K ions through the receptive membrane but not by the entry of Cl ions. As a continuation of the above experiment the ability of mono-, di- and trivalent cations to substitute for N ions was examined this year. When Na ions in Ringer's solution was replaced by one of these cations, the negative EOG decreased in amplitude and in many cases disappeared. When Na ions and K ions were exchanged in Ringer's solution, the negative EOGs reversed their polarity. When recovery of these reversed (originally negative) EOGs were examined in the Ringer's solutions in which Na ions was replaced by one of the cations, they recovered only partially and the recoveries were not maintained. Only when K ions was replaced by Na ions (normal Ringer's solution), the negative EOGs recovered completely and could maintain their amplitudes. Thus, the indispensability of Na ions was proved. The cation permeability was considered on the basis of the ion size. By means of a microelectrode, differential sensitivity to various odours of single olfactory cells were shown. The mechanism of olfactory fatigue was studied by recording the response of the olfactory nerv twigs. The result indicates that the olfactory adaptation essentially occurs in the higher olfactory centers. The importance in olfaction of the trigeminal nerve was shown by recording the responses to many kinds of odors. This nerve is more sensitive to camphoraceous, pepperminty and pungent odors than the olfactory nerve. In order to clarify the mechanism of odors discrimination i the olfactory bulb, four camphoraceous and four pepperminty odors were applied and the numbers of the spike discharges of single cell to these odors were counted. Good correlations were generally foun between the numbers of spike discharges and the profiles of the odorous molecules, although there were some exceptions. (Author's abstract, modified)

12449

Nobuo, M.

THE PROBLEMS OF ODOR NUISANCE. I. ODORS AND LIFE. Taiki Osen Kenkyu (J. Japan. Soc. Air Pollution), 2(1): no pagination given, 1967. Translated from Japanese. 14p.

Certain odors are categorized as natural or artifical, and the characteristic smell of each odor is noted. The chemical structure of several odors is shown, including methionine, L-tryptophan, L-lysine, L-arginine, and allium.

12662

W. T. McKean, Jr., B. F. Hrutfiord, K. V. Sarkanen

KINETICS OF METHYL MERCAPTAN AND DIMETHYL SULFIDE FORMATION IN KRAFT PULPING. Tappi, 51(12):564-567, Dec. 1968. 10 refs.

Earlier rate studies on the formation of methyl mercaptan and dimethyl sulfide in kraft pulping were repeated under carefully controlled conditions. While the rate data obtained were in good agreement with earlier results, somewhat higher values were obtained for the rate constant of dimethyl sulfide formation (k2) at temperatures above 160 degrees C. This difference in results was traced to pH effects. It was possible to demonstrate that the rate of dimethyl sulfide formation is directly proportional to mercaptide concentration, while un-ionized mercaptan does not react with lignin methoxyl groups. As a consequence, the alkali charge in kraft pulping has a definite influence on the ratio of mercaptan to dimethyl sulfide that are formed in the cook. Noncondensibles escaping from the blow gases of mills cooking to alkali-exhaustion (-pH 10.5) are therefore more obnoxious than those from mills maintaining adequate residual alkalinity. Sufficient actibe alkali charge is therfore a recommended practice for older installations. (Author's Abstract)

13107

Takagi, S. F., H. Kitamura, K. Imai, and H. Takeuchi

FURTHER STUDIES ON THE ROLES OF SODIUM AND POTASSIUM IN THE GENERATION OF THE ELECTRO-OLFACTOGRAM. EFFECTS OF MONO-, DI-, AND TRIVALENT CATIONS. J. Gen. Physiol., 53(1):115-130, Jan. 1969. 47 refs.

In the negative electro-olfactogram (EOG) generating process a cation which can substitute for Na(=) was sought among the monovalent ions, Li(=), Rb(=), Cs(=), NH4(=), and tetraethylammonium, the divalent ions, Mg(2=), Ca(2=), Sr(2=), Ba(2=), Zn(2=), Cd(2=), Mn(2=), Co(2=), and Ni(2=), and the trivalent ions, Al(3=) and Fe(3=). In Ringer solutions in which Na(=) was replaced by one of these cations, the negative EOG's decreased in amplitude and could not maintain the original amplitudes. In K(=)-Ringer solution in which Na(=) was replaced by K(=), the negative EOG's reversed their polarity. Recovery of these reversed potentials was examined in modified Ringer solutions in which Na(=) was replaced by one of the above cations. Complete recovery was found only in the normal Ringer solution. Thus, it was clarified that Na(=) plays an irreplaceable role in the generation of the negative EOG's. The sieve hypothesis which was valid for the positive EOG-generating membrane or IPSP was not found applicable in any form to the negative EOG-generating membrane. The reversal of the negative EOG's found in K(=)- , Rb(=)- , and Ba(2=)-Ringer solutions was attributed to the exit of the internal K(=). It is, however, not known whether or not Cl(-) permeability increases in these Na(=)-free solutions and contributes to the generation of the reversed EOG's. (Author abstract modified)

13670

Shaw, A. C. and K. T. Waldock

VANILLIN ANALYSIS AND ODOUR EVALUATION BY GAS CHROMATOGRAPHY. Pulp Paper Mag. Can., 68(3):T-118-T-122, 1967. 7 refs.

Separation by gas chromatography of vanillin and its coproducts, formed during alkaline-air oxidation of lignosulfonates in waste sulfite liquor, can be accomplished on a variety of polar liquid phases. Retention times are relatively unaffected with increasing polarity of the liquid phase. Obtaining a well- defined symmetrical peak suitable for peak area measurements is more difficult. Polar materials commonly adsorb on chromatographic solid supports, and vanillin is particularly prone to do this. Adsorption is minimized on fluorocarbon supports, provided polar liquid phase loadings are kept within narrow loadings. Even on glass surfaces, vanillin tends to decompose during vaporization. Evidence suggests that vanillin can be vaporized from chloroform solution on a clean glass surface with negligible decomposition. In most of its applications, odor is an ultimate criterion of vanillin quality. An objective measurement of odor can be obtained by examination of the vapor in equilibrium with a finely divided vanillin sample. Gas chromatography reveals the presence of trace elements that are undetectable by direct chromatographic examination of the vanillin product.

14987

Edwards, T. H.

ANALYSIS OF INFRARED ABSORPTION SPECTRA OF ASYMMETRIC MOLECULES (FINAL REPORT). Michigan State Univ., East Lansing, Dept. of Physics, Contract AF 19(628)-4009, Proj. 8603-03-01, AFCRL-68-0637, 40p., Dec. 1968. 12 refs. DDC: AD 682838

Theoretical expressions for centrifugal distortion in planar asymonetric molecules of the type non-linear XYX, and their relationship to more fundamental molecular parameters, are developed. A modified contact transformation was applied to the Hamiltonian to arrive at the form appropriate when there is an accidental near-degeneracy between vibrational states (V1, V2, V3) and (V1-1, V2, V3 plus 1). The revised Hamiltonian was incorporated into computer programs for simultaneous analysis of pairs of infrared absorption bands. Spectra of H2S, and of several isotopes of H2Se, and of H2Te were obtained and analyzed to yield values of numerous molecular parameters for these molecules. (Author abstract modified)

16455

Turk, Amos

CONCENTRATIONS OF ODOROUS VAPORS IN TEST CHAMBERS. In: Basic Principles of Sensory Evaluation. American Society for Testing and Materials, Philadelphia, Pa., STP-433, p. 79-83, 1968. 2 refs.

Factors that determine the changing and equilibrium concentrations of odorous vapors in test chambers were mathematically considered. Processes that tend to increase the concentration of odorous vapors are the generation of vapor within the space, and the introduction of vapor by replacement of chamber air by ventilation or infiltration with outdoor air of higher vapor concentration. Processes that tend to decrease the concentration of odorous vapors are the treatment of the chamber air by a vapor-reducing device, and the removal of vapor by replacement of chamber air by ventilation or infiltration with outdoor air of lower vapor concentration. The equations for the concentration of vapors at any time and at equilibrium were given. The simplified equations which apply to only special cases were also given for the following: ventilation air is pure, when no vapor is generated or injected, when the vapor reducing device is 100% efficient, when the chamber is originally pure, and when the air is tight. Equations are given for combinations of the conditions. A mixing factor may be applied to account for the fact that dilution of air is not instantaneous, and that concentration fall-off rates are actually smaller than the ideal values given by the equations. An equation is also given to calculate the efficiency of a vapor reducing device in a chamber from odor dilution methods determined at different times, or to calculate the time interval between sensory tests that is needed to provide a specified diminution of vapor concentration.

16696

Morton, Frank, P. J. King, and A. McLaughlin

HELICAL-COIL DISTILLATION COLUMNS PART I: EFFICIENCY STUDIES. Trans. Inst. Chem. Engrs. (London), 42(8):T285-T295, 1964. 26 refs.

Efficiency tests of four helical-coil distillation columns with tube diameters of 1.95, 1.1, 0.495, and 0.425 cm were carried out at atmospheric and reduced pressures with three test mixtures: chlorobenzene/ethyl benzene; n-heptane/methyl cyclohexane; and n-hexadecane/n-heptyl benzoate. At atmospheric pressures, the measured efficiencies of the columns were inversely proportional to tube diameter. When the experimental results were plotted in terms of height of transfer unit vs vapor Reynolds number, a single line was obtained which correlated the results for the four coils investigated. This indicates that the efficiencies of helical-coil columns at atmospheric pressures can also be correlated on the basis of negligible liquid-phase resistance. At reduced pressures, there was no direct relationship between height of the transfer unit and tube diameter, nor could experimental data be correlated only on the basis of vapor-phase resistance. This implies that liquid-phase resistance at reduced pressure is a significant portion of the total resistance. The increase in the liquid-phase resistance is attributed to higher viscosities and lower diffusivities encountered at reduced pressures. A comparison of the 1.1 cm diameter helical coil column with other high efficiency columns shows that at partial reflux and 20 mm Hg abs, the helical coil unit is particularly useful for low- pressure fractionation of heat-sensitive materials.

16828

Thomas, J. F., K. H. Jones, and D. L. Brink

A MECHANISM TO EXPLAIN THE PRODUCTION OF MALODOROUS PRODUCTS IN KRAFT RECOVERY FURNACES. Tappi, 52(10):1873-1875, Oct. 1969. 9 refs.

Some fundamentals of combustion which may offer an explanation for the origin of malodorous sulfur pollutants which originate in kraft recovery furnaces and which may indicate a method to control these malodors are reviewed. The combustion can be characterized by initial endothermic reactions, which degrade the organic part of the black liquor into smaller and smaller fragments, and by the competing exothermic reactions of oxidation and recombination. The recombination reactions are responsible for the formation of the malodorous compounds. It is suggested that by separating the oxidation reactions from the endothermic and recombination reactions, a furnace effluent could be produced which would be completely odor free. (Author's Abstract)

17801

Wright, R. H.

ODOUR AND MOLECULAR VIBRATION. Nature (London), 209(5023):571-573, Feb. 5, 1966. 2 refs.

The postulates of the vibrational theory of odor are elaborated and applied to an investigation of benzonitrile, a substance with bond-defined molecules and known normal-mode spectroscopic frequencies which has a distinctive bitter-almond smell. To identify the osmically active frequencies, its possible 'populated frequencies' are given and collated with similar values for nitrobenzene and benzaldehyde, which have similar odors. Results indicate an apparent association of osmic activity with out-of- plane oscillations of the benzene rings. Three criteria of osmically active vibrations are hypothesized: they must have low frequency; they must involve all or most of the molecule; and they must have substantial components perpendicular to the receptor surface. Information theory suggests that the whole array of smells derives from about 25 primary odors; if the almond odor is due basically to the three frequencies deduced in the experiments, it is a three-primary odor. Other odors would presumably correlate with other combinations of frequencies, although this has not yet been demonstrated. It is concluded that the vibrational theory should include the understanding that two normal modes can be excited in the same molecule at the same time, and that when this occurs, the result must be a new frequency which is the difference between the frequencies of the two normal modes.

19061

Amoore, John E., James W. Johnston, Jr., and Martin Rubin

THE STEREOCHEMICAL THEORY OF ODOR. Sci. Am., vol. 210:42-49, 1964.

New evidence has shown that the geometry of molecules is the main determinant of odor, and a stereochemical theory of the olfactory process has been developed. It has been suggested that the olfactory system is composed of different types of receptor cells, each representing a distinct odor. The odorous molecules produce their effects by fitting into receptor sites on these cells. There are seven primary odors: camphoraceous, musky, floral, peppermint, ethereal, pungent, and putrid. Every known odor can be made from these seven by mixing them in certain proportions. Camphoraceous molecules are spherically shaped and approximately seven angstroms in diameter. Therefore, it is believed that the receptor site for these molecules is a hemispherical bowl about seven angstroms in diameter. The musky odor is accounted for by disk-shaped molecules about 10 angstroms in diameter. The floral odor is caused by disc-shaped molecules with a flexible tail attached. The peppermint odor is caused by wedgeshaped molecules with an electrically polarized group of atoms, capable of forming a hydrogen bond, near the point of the wedge. The ethereal odor is due to rod-shaped molecules. In each of these cases, the receptor site is the nerve endings, presumably the shape and size of the molecule. Pungent odors are caused by electrophilic molecules, while putrid odors are due to nucleophilic molecules. Tests conducted to confirm the validity of this theory are also discussed.

19063

Hornstein, Irwin and Roy Teranishi

THE CHEMISTRY OF FLAVOR. Chem. Eng. News, vol. 45:92-108, April 3, 1967. 8 refs.

The chemistry of flavor, as related to odor and taste, is discussed. It is generally agreed that there are four basic tastes: sweet, sour, salty, and bitter. Sour tasting compounds are generally acidic. An absolute correlation between taste and physical and chemical properties of salts has not been established, but, in general, low molecular weight salts are salty and, as the molecular weight increases, the taste shifts to bitter. No valid theory for predicting which substances will be sweet or bitter exists. There have been many attempts to correlate chemical structure and odor, but the results have been disappointing. Compounds with different structures may have similar odors, while compounds with similar structures may have different odors. The physiological mechanisms which generate olfactory and taste impulses are discussed. The low thresholds for odoriferous compounds and the low concentrations of these components in food make chemical analyses for flavor components difficult. Mass spectrometry is the most sensitive analytical method when used with gas-liquid partition chromatography. Despite the steadily increasing accumulation of factual information concerning the volatile compounds associated with flavor, no conclusions concerning the specific nature of flavor have been obtained.

19102

Takagi, Sadayuki F., Gordon A. Wyse, Harunobu Kitamura, and Katsuhiro Ito

THE ROLES OF SODIUM AND POTASSIUM IONS IN THE GENERATION OF THE ELECTRO-OLFACTOGRAM. J. Gen. Physiol., 51(4):552-578, 1968. 65 refs.

The roles of sodium, potassium, chloride, calcium, barium and other ions in the 'on' and 'off' types of electronegative mucosal potentials (EOG) were studied in order to clarify the ionic mechanisms underlying these potentials. The experimental material was olfactory epithelium excised from frogs, with menthone, amyl acetate, ethyl ether, and chloroform vapors as stimulants, and normal Ringer's solution of varying compositions as the test environment. Olfactory mucosal potentials were recorded with a pair of nonpolarizable electrodes. Detailed results for replacements and changes of Na(I) and K(I) in the Ringer solutions are given which demonstrate the essential role of these ions in negative EOG's. Thus, the EOG decreased in amplitude and in some cases nearly or completely disappeared when Na(I) in the solution was replaced by sucrose, Li(I), choline (I), tetraethylammonium (I), or hydrazine. In the K(I)-free solution, the negative EOG's first increased and then decreased in amplitude. It was also concluded that Ba(II) interferes only with Cl(-) influx, and that the negative EOG's are elicited by an increase in permeability of the olfactory receptive membrane to Na(I) and K(I) but not to Cl(-). From the ionic mechanism it is inferred that the negative EOG's are in most cases composites of generator and positive potentials. The ionic basis of these potentials was compared with that of other receptor potentials and a similarity of the negative EOG's with the end plate potential is suggested.

22429

Yoshida, Masaaki

THEORIES ON THE SENSE OF SMELL. PART II. (Kyukaku ni kansuru gakusetsu (2)). Text in Japanese. Akushu No. Kenkyu (Odor Res. J. Japan), 1(2):1-8, June 20, 1970. 7 refs. Part I, Ibid., 1(1):9-15, April 20, 1970.

Theories of the interaction between molecules in olfaction are presented. Amoore assumed that the sensory organ has holes for odorant molecules of a particular size, configuration, and electrical affinity. He formulated the similarity of the smell and the similarity of the chemical structure of various odorant molecules. Some correlations between the two were found. Johnston showed that an odor named woody note can be synthesized by blending the 7 standard smells defined by Amoore. Wright assumed that there are 25 fundamental smells detectable by the human nose. The total wave number range covers 0.80-0.650 cm, which is divided into 25 sections of 0.8-0.50 cm width, each overlapping with the adjacent ones. Benzonitryl, nitrobenzene, and benzaldehyde were chosen, and their normal mode frequencies less than 0.500 cm were listed. All of the three had frequency regions of 0.174 plus or minus 0.002, 0.225 plus or minus 0.004, and 0.400 plus or minus 0.0003 cm in common. Wright asserted that these frequencies give the almond smell which is common to the three substances. A psychological experiment was also performed in order to establish the theory.

22430

Yoshida, Masaaki

THEORIES OF THE SENSE OF SMELL. PART I. (Kyukaku ni kansuru gakusetsu (1)). Text in Japanese. Akushu No Kenkyu (Odor Res. J. Japan), 1(1):9-15, April 20, 1970. 5 refs. Part II. Ibid., 1(2):1-8, June 20, 1970.

Theories on the mechanism of electrical changes in the neuron receiving odoriferous molecules, different reaction patterns by different molecules, and the properties of the molecules with respect to threshold value, intensity, and characteristic of the odor are reviewed, together with the classification and description of the odor. The impluse traveling through the nerve fiber from the olfactory membrane is of the order of 0.07 v. Since the membrane of the nerve cell is only several molecules thick, the field intensity in the membrane is of the order of 100,000 volt/cm. The field instantaneously vanishes when the pulse passes, and recovers by ion exchange between the inside and outside of the nerve cell. The impluse is not amplitude modulated, but is frequency modulated. Physiologists unanimously agree up to this point as to the general mechanism, but the mechanism of impulse generation at the terminal of nerves in the nose is not yet clarified. Chemical reactions, enzymes and stereostructure theorie have been proposed in order to explain the generation of the impulse. Some people considered an indirect action, such as, vibration, wave, or radiation. Some of the strong theories recognizing the phenomenon as an interfacial one or interaction between the molecules are also explained.

23187

Hird, S. A. and L. L. Lloyd

THE ACTION OF SULPHUR DIOXIDE UPON OILS AND THEIR FATTY ACIDS. J. Soc. Chem. Ind., 31(7):317-319, April 15, 1912.

A number of oils, and independently the fatty acids obtained from the oils, were subjected to the action of sulfur dioxide under different conditions; in most cases, the physical and chemical properties were found to alter. Generally, the iodine value was reduced, the saturation number increased, and the melting point and solubility were affected. Production of a dark color and the polymerization of most of the oils or fatty acids appeared to be governed by the iodine value, because the higher the iodine value, the more rapid was the darkening and thickening of the oils or fatty acids. Yet, this view was not supported by the results of the action of SO2 upon castor oil when treated in the cold, or to a greater extent upon practically pure oleic acid. The darker color obtained with the oils or fatty acids by means of oxygen and SO2 is no doubt due to the oxidizable oils acting as catalytic agents in the transfer of oxygen from the air to the SO2, the production of sulfuric acid being consequently cumulative. Quicker drying oils give color reactions most readily, while their amount of sulfuric acid is higher. On treatment with sulfur dioxide, especially in the presence of air, the oils develop an unpleasant odor, whereas the fatty acids are scarcely altered in odor. The reactions which result when oils and fatty acids are subjected to SO2 are presented tabularly.

24354

Peyron, Louis

MOLECULAR STRUCTURES AND ODORS. (Edifices moleculaires et odeurs). Text in French. France Parfums, vol. 7:397-405, 1964. 42 refs.

The problem of the relationship between odors and molecular structure is most intricate. Interrelations appear to exist and should exist, but so far only numerous facts of limited importance have been reported. The solution to the problem, the broad, simple and general theory which must govern these relations, is still missing. Research undertaken to solve this problem has a triple aim: scientific, enconomic, and aesthetic. The rules which allow for approximate prediction of anticipated ordors are discussed. Theoretical forecasting of formulas for new compounds, original as far as odor or structure are concerned, is not possible at present. Nature still reserves very bright days for the members of the perfume industry, both in terms of raw materials and inspiration in the synthesis of new compounds. (Author abstract modified)

24531

Guillot, M.

MOLECULAR STRUCTURE AND ODOR. Ion, vol.10:72-75, 1959. 5 refs. Translated from Spanish by Robert I. Henkin, National Institutes of Health, Bethesda, Md., Translating Unit, 9p., Nov. 7, 1969.

After summarizing hypotheses advanced at a 1957 symposium to explain the relationship between molecular structure and odor, conclusions are presented on possible correlations between the two factors. In the case of certain groups of similar molecules, there is a relationship between molecular structure and odor, since a small variation in the formula brings about a correlative change in the odor. With other molecules, such as steroids, there is no correlation. The theory of an interdependence between molecular structure and odor can be reduced to the simply statement that all the chemical and physical properties of a substance with a definite molecular structure are linked to this structure, which is in turn related to the infrared and Raman spectra. It is natural, therefore, that when the molecular structure and odor are related in a simple way, a correlation with the spectra is also seen. In this way, however, the vibrations of molecules intervene only indirectly.

25761

Compressed Gas Assoc., Inc., New York, N. Y.

SULFUR DIOXIDE. Pamphlet G-3, 21p., 1964. 12 refs.

A comprehensive description of the compound sulfur dioxide and all of its associated handling problems is presented. Its composition, physical and chemical properties, methods of manufacture, and commercial uses are described. The types of containers available for SO2, including disposable cans, cylinders, tank cars, and portable tanks, are discussed, as well as the regulations pertaining to such containers. Storage methods for the various types of containers are detailed. Handling and withdrawing procedures for SO2 in both liquid and vapor phase are mentioned. Safety precautions should be taken when leaks are detected in containers. Even when equipped with a safety mask, the operator should remain in the contaminated area only long enough to make the necessary adjustments. Physiological effects of SO2 include irritation of the mucous membranes of the eyes, nose, throat, and lungs due to the formation of sulfurous acid. The physiological responses to various concentrations of SO2 are documented. SO2 is readily detected in concentrations of 4 ppm by its odor. First aid suggestions in the event of emergencies are included.

26529

Ochi, Jinzaburo, M. Ishikawa, and Kiyoshi Komori

OCCURRENCE OF ABNORMAL ODOR IN TAP WATER DUE TO PLANKTONS AND ITS CONTROL. (Suidosui no purankuton ni yoru ijo shukihassei to sono taisaku ni tsuite). Text in Japanese. Shikoku Koshueisei Gakkai Zasshi (J. Shikzoku Z0oc. Public Health), no. 15:54-56, Feb. 1970.

In the beginning of May 1969, tap water in Iyo-Mishima and Kawz2nzo started to produce a muddy and moldy odor. The investigation conducted by the public health service showed that the cause was probably due to the unnatural occurrence of planktons (diatoms) in the water zof Yanagawa Dam. The level of the water in the dam had not declined more than 15 m for the past year, and the water had become stagnant. This led to the abundance of nitrogen and phosphorus compounds arising from the decomposition of organic matter and accumulation of sludge at the bottom of the lake. In addition, the rise in water temperature due to the abnormal meteorological condition (high temperature) in spring had led to a drastic change in the water circulation in the lake and the production of planktons was promoted. For emergency measures, wate intake was changed to the gate at a lower water level, 0.8 ppm of copper chloride was injected, and 1.2 ppm of chlorine was added. The odor completely disappeared within two months. At that time, the water level had risen due to the rainy season and the dam was full. As future measures, investigation and removal of upstream pollution sources, elimination of bottom and intermediate water at the full-water period, and the changing of lake water were suggested.

29649

Takahashi, T.

A FEW OBSERVATION ON THE GENERATION MECHANISM OF OBNOXIOUS ODOR. (Akushu busshitsu hassei kijo no 2, 3 no kosatsu). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(4):33-38, March 1971. 9 refs.

Much energy has been spent on how to cope with odor problems, but only after they happen. Therefore, odor generation was studied. The automatic oxidation chain reaction of unsaturated fats starts when the R-H loses hydrogen, causing a free radical. The process of automatic oxidation can be known by measuring the amount of oxygen absorbed or the absorption speed (POV). In the initial induction period, there is little oxygen absorbed and no generation of POV. Then the reaction starts, and the amount of oxygen absorbed and POV rapidly increase. The ROOH which is generated is comparatively stable, but is separated by metals, light, and temperature, causing the free radical. Automatic oxidation is promoted, and various secondary products are made. When fats are heated to a high temperature, carboxyls, carbonyls, acrolein, and carbonic acid gas are generated, as in garbage combustion. The Meyrard (?) reaction is the most well-known amino acid reaction and generates melanoidin. When alpha-dicarbonyl compounds cause Strecker decomposition, an obnoxious odor is given off. Alpha-amino acids are easily oxidized, and generate odors at a certain concentration, for example, the decomposition of alanine into acetaldehyde and ammonia, or of methionine into acrolein and mercaptan. Purefaction is a kind of fermentation which happens in the presence of microbes. Protein is th easiest to putrefy. Ptomaine, sometimes called the animal or putrefaction alkaloyd, is a mixture of nitrogen compounds of the amine group. The putrefaction of protein produces hydrogen sulfide, mercaptan, indole, catole, ammonia, and amine. Thus, the substances generated by the automatic oxidation of fats and heated decomposition, are no different from those generated by the general oxidation in a chemical reaction. Although they are unstable, they can be supplied as standard samples. Most of the odorous substances change the quality of odor radically and more than two kinds of substances may cancel each other or have multiple effects. Control should be made after quantitative analyses have been made and after seeking the relationship between the human sense of smell and the values arrived at by instrumental analysis. Authoritative panel members would judge the smells.

32271

Wright, R. H. and R. E. Burgess

SPECIFIC PHYSICOCHEMICAL MECHANISMS OF OLFACTORY STIMULATION. Ciba Foundation, London (England), Taste Smell Vertebrates, Ciba Found. Symp., 1969, p. 325-342. 29 refs.

The course of an odorous molecule as it moves into contact with the receptor organ was traced. The possible ways in which its vibrational character might enable it to exercise a selective stimulation and thereby impress its own specificity upon the organism in examined. The transport and electrical dipole of the molecule, molecular vibration, interacting dipoles, limiting osmic frequencies, and thermodynamic considerations are discussed. The vibrational properties of a molecule are capable of imparting the requisite degree of specificity to several kinds of interaction, and the upper and lower limits to the scale of osmic frequencies prescribed by the theory coincided with the experimental limits. A permanent or induced dipole may help to orient the stimulus molecule with respect to the polarized membrane of the receptor nerve, and the vibrational modulation of the moment could govern the transfer of energy between stimulus and receptor. The differential stimulation of selectively sensitive receptors then enables the stimulus to impress its individuality upon the organism, and the essentially physical nature of the interaction makes possible the high sensitivity of the olfactory sense. (Author summary modified)

33084

SHAPE OF SMELLS. Agri. Res., 18(7):3-4, Jan. 1970.

Evidence is presented which not only strengthens the stereochemical theory of odor, but which suggests that the theory could be useful in explaining the activity of alarm pheromones of various species of ants and possibly other social insects. Pheromones are natural substances emitted by insects that cause a typical reaction in other insects able to detect the substance. Silhouettes were made of scale models of the chemical compounds which could cause the typical alarm response in ants. They were examined by a unique pattern recognition machine, a hybrid instrument consisting basically of a modified television camera linked to a special computer. The machine is oriented for any given assignment by training it on the silhouette of a reference molecule (in this case the natural pheromone, 2-heptanone). When it is shown silhouettes of other molecules, it compares them with those of the reference molecule and prints out the degree of similarity within five seconds. Substances with a remarkable range of chemical variation caused alarm activity, provided their molecular shape conformed closely to that of 2-heptanone.

35651

Jones, F. Nowell

OLFACTORY THRESHOLDS IN THE INTERNATIONAL CRITICAL TABLES. Science, 118(3064):333, Sept, 18, 1953. 2 refs.

Olfactory thresholds in the International Critical Tables are expressed as molecules/cc of air. Because of an error in the formula used to translate threshold data into this common unit, the thresholds in the tables are in error by a factor of 100. The Avogrado number, which is the basis of the calculation, should read 6.023 times 10 to the 23rd power, not 6.06 times 10 to the 21st power. A simple procedure for correcting table values is given.

G. EFFECTS-HUMAN HEALTH

00177

H. Buchberg, M. H. Jones, K. G. Lindh, and K. W. Wilson

AIR POLLUTION STUDIES WITH SIMULATED ATMOSPHERES. California Univ., Los Angeles, Dept. of Engineering. (Rept. No. 61-44.) July 1961. 185 pp.

Part I of this report deals with the statistical relations among interacting atmospheric variables. Also contained in this report are the results of several auxiliary or supporting studies as follows: Air Purification Studies; Development of an Eye Mask for the Measurement of the Threshold of Eye Irritation; Development of an Omnidirectional Solar Radiometer for a Limited Spectral Region Centered about 0.36 microns; A Comparison of Concentration and Duration as Measures of Threshold for Eye Irritation; A Comparison of Threshold to Eye Irritation Resulting from Reacted Air Mixtures Sampled at Different Points in the Exposure System; A Comparison of Odor Threshold and Eye Irritation Threshold for Formaldehyde, Acrolein, and Ozone. (Author)

00208

R. Cederlof, L. Friberg, E. Jonsson, L. Kaij, and T. Lindvall

STUDIES OF ANNOYANCE CONNECTED WITH OFFENSIVE SMELL FROM A SULPHATE CELLULOSE FACTORY. Nord. Hyg. Tidskr. Vol. 45:39-48, 1964.

The primary aim of the investigation was to obtain an objective measure of the extent and development of the annoyance among the population as a whole in the most exposed districts, i.e. in the muncipalities of Morrum and Asarum, and in Karlshamn. Secondary aims were to study the extent to which the petitions to the public health authority constituted a reliable measure of the actual nuisance experienced by the signatories and also the extent to which factors other than exposure to the pollution influenced the reactions to the nuisance. Of the population in the district investigated, 10-15% suffered major annoyance from the factory, while the corresponding figure for those living in the immediate vicinity of the factory was just under 20%. It should be noted, however, that the purpose of the investigation was not disguised, so that the degree of annoyance found is probably rather too high. Among those who had signed the petition complaining of the existing conditions, 47% reported that they had not experienced any annoyance from the flue gases at the time of the investigation. Only 31% reported major annoyance. On the other hand, almost half considered that the smell was much the same as when they had signed the petition. The petition must accordingly be rejected as a reliable measure of the extent of the annoyance. The results also show that the annoyance derives from factors other than the exposure to the factory. Thus annoyance is reported more frequently among those with previous respiratory and cardiovascular diseases, with a propensity to neurosis, sensitivity to airplane noise, propensity to displeasure with other factors of community life and no connection with the factory.

00715

O. Angleraud F. Borrelli

ODORIZATION AND ITS PROBLEMS. (Die Odorierung und ihre Probleme.) Gas Wasserfach (Munich), 107(21):573-581, May 27, 1966.

For easy and rapid detection of some dangerous gases, an unmistakable and unpleasant odorifying agent is added to the gas. Quantitative measurement in this area is difficult, but the authors set out to define their terms and refine measurements as mcuh as possible. Intensity of odor is based on Weber's law which relates intensity directly to the log of concentration. From this law, grades of odor intensity ranging from 0 to 5 are defined, with 2 being the average intensity at which a normal person can detect an odor with assurance, and 0.5 being the minimum detectable. The safety coefficient in odorizing a gas is the ratio of the least damaging concentration of the gas in question to the warning concentration. For example, in France and Italy, this coefficient is set at 5 vol %, so that 1% of natural gas or 0.4% propane should be detectable. With poisonous gases, such as carbon monoxide or catalytically reformed gas, the safety coefficient should be higher. The authors conducted a series of experiments in and around natural gas and refinery installations in France and Italy. They also conducted laboratory tests using a specially built room in which the concentrations of gas and odorifying agent could be controlled. Various types of natural gas from France had practically identical odor intensities. Odor intensities of commercial odorifying agents were also determined. Experiments carried out at the Turin gas works of 'Italgas' indicated that increasing the concentration of odor additive even slightly greatly increased the incidence of complaints, especially during the winter months.

03788

H. F. J. Wenzel and O. V. Ingruber

CONTROLLING PROBLEMS OF AIR AND WATER CONTAMINATION. Paper Trade J. 151, (3) 42-7, Jan. 16, 1967.

The nature of the substances causing kraft pulp mill odor problems; the manner and amounts in which they are produced; analytical methods for determining them; the tolerable limit of concentration; the threshold of perceptability; and control measures are reviewed. Hydrogen sulfide, methylmercaptan, dimethylsulfide, and to a lesser extent, dimethyldisulfide, are involved.

05942

E. V. Elfimova

DATA FOR THE HYGIENIC EVALUATION OF HYDROCHLORIC ACID AEROSOL (HYDROCHLORIDE GAS) AS AN ATMOSPHERIC POLLUTANT. (In: Limits of allowable concentrations of atmospheric pollutants. Book 6.) U.S.S.R. Literature on Air Pollution and Related Occupational Diseases. Vol. 9. pp. 18-28. (1962). Russ. (Tr.)

It was shown that 0.1 mg/cu.m. is the concentration of threshold hydrochloric acid aerosol odor perception, that 0.05 mg/cu.m. is the odor non-perceptible concentration, that 0.6

mg/cu.m. is the concentration of threshold reflex effect on optical chronaxy, and 0.2 mg/cu.m. the concentration of threshold reflex effect on eye sensitivity to light. The concentration of threshold effect on digito-vascular tonicity is 0.5 mg/cu.m., and the threshold concentration of change in the rhythm and depth of respiratory movement is at 0.1 mg/cu.m. of the aerosol. On the basis of the above results it is recommended that 0.05 mg/cu.m. be accepted as the limit of allowable single concentration of hydrochloric acid aerosol in atmospheric air. Results of this investigation indicated that 10 mg/cu.m. of the aerosol, representing the limit of allowable concentration for working premises, elicited sharp shifts in the physiological reactions. The method used for the determination of hydrochloric acid aerosol in atmospheric air can be applied to the determination of the aerosol in the presence of H2SO4 aerosol and in the presence of free chlorine and chlorides. The present investigation indicated that atmospheric air in the vicinity of a magnesium plant is highly polluted with hydrochloric acid aerosol, that such air pollution extended over considerable distances from the magnesium plant, and that the sanitary protection zones around magnesium plant discharging hydrochloric acid aerosol, in the absence of gas purifying equipment, should be in excess of 3,000 m. Plans for future magnesium plants should mandatorily include provisions for the installation of hydrochloric acid absorbing equipment. 05942 E. V. Elfimova

05943

A RESTUDY OF THE MAXIMAL ALLOWABLE SINGLE CONCENTRATION OF CARBON DISULFIDE IN ATMOSPHERIC AIR. In: Limits of Allowable Concentrations of Atmospheric Pollutants. Book 6. Translated from Russian in: U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, vol. 9:29-39, 1962, by R. S. Gil denskjol d and B. S. Levine.

Examinations of air samples indicated that, even at 3000 meters from the investigated plant, the air contained 0.03 mg/m3 of carbon disulfide. Results of tests conducted with the aid of most odor perception sensitive persons indicated that 0.05 mg/m3 is the concentration of threshold odor perception for CS2 and that 0.04 mg/m3 is the odor nonperceptible concentration of CS2. The concentration of threshold carbon disulfide reflex effect, as determined by the method of optical chronaxy, is 0.04 mg/m3 and the subthreshold concentration is 0.03 mg/m3. The limit of allowable CS2 concentration should not exceed 0.03 mg/m3. Results of the present investigation suggest that the present 2000 m width of sanitary clearance zones surrounding viscous plants should be widened to 3000 m. Sanitary bodies must insist on the immediate installation of effective equipment for the purification of viscous combine gas discharges containing CS2. Gases discharged by viscous plants contain vapors other than CS2. It is, therefore, suggested that a comprehensive and complex study of the atmospheric air in vicinities of viscous plants be initiated without undue delay.

05946

Stayzhkin, V. M.

HYGIENIC DETERMINATION OF LIMITS OF ALLOWABLE CONCENTRATIONS OF CHLORINE AND HYDROCHLORIDE GASES SIMULATENOUSLY PRESENT IN ATMOSPHERIC AIR. (In: Limits of allowable concentrations of atmospheric pollutants. Book 6.) U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 9, pp. 55-61. (1962). Russ. (Tr.)

This study was confined to the use of low concentrations of chlorine and hydrochloride gases and their effect on the physiological reactivity of man. The methods of investigation were: determination of threshold odor perception, optical chronaxy and adaptometry. Results of this investigation indicated that 0.75 mg/cu m was the concentration of threshold chlorine odor perception, and 0.02 mg/cu m the concentration of threshold hydrochloride gas odor perception. The simultaneous presence in the air of chlorine and hydrochloride gases was not odor perceptible when the gases co-existed in the following ratio concentrations: 0.3 mg/cu m of chlorine and 0.1 mg/cu m of hydrochloride gas, also 0.2 mg/cu m of chlorine and 0.13 mg/cu m hydrochloride gas. The additive physiological and neurological effects of simultaneously present chlorine and hydrochloric gases in the air were in the nature of arithmetical summation. Optical chronaxy tests indicated that threshold reflex effects were produced by chlorine and hydrochloride gas simultaneously present in the air in the following ratio combinations: chlorine, 0.3 mg/ cu m and hydrochloride gas, 0.3 mg/cu m and also chlorine, 0.3 mg/ cu m and hydrochloride gas, 0.3 mg/cu m. Tests of eye sensitivity to light indicated that the combination of 0.2 mg/cu m of chlorine and 0.1 mg/cu m of hydrochlorinde gas constituted a threshold combination mixture of the 2 gases which elicited changes in eye sensitivity to light. The present investigation also indicated that the previously adopted limits of allowable single chlorine concentration of 0.1 mg/cu m and of hydrochloride gas of 0.005 mg/ cu m simultaneously present in atmospheric air were below the threshold of odor perception and of effect on reflex activity.

05949

G. I. Solomin

HYGIENIC EVALUATION OF DINYL AS AN ATMOSPHERIC AIR POLLUTANT. (In: Limits of allowable concentrations of atmospheric pollutants. Book 6.) U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 9. pp. 82-92. (1962). Russ. (Tr.)

Results of odor perception study conducted with 15 persons indicated that the concentration of threshold dinyl vapor odor perception was 0.06 mg/cu.m. and that the concentration of threshold dinyl reflex effect on eye sensitivity to light was 0.04 mg/cu.m. The concentration of threshold dinyl electrocortical conditioned reflex formation was 0.03 mg/cu.m., and the subthreshold concentration was 0.01 mg/cu.m. The maximal single allowable dinyl vapor concentration for atmospheric air should not exceed 0.01 mg/cu.m. Dinyl concentrations of 10 and 0.2 mg/cu.m. under conditions of chronic vapor inhalation elicited changes in the muscle antagonist's chronaxy in white rats. Rate of coproporphyrin elimination with the urine was lowered in rats which chronically inhaled 10 and 0.2 mg/cu.m. of dinyl vapor. Prolonged inhalation of air containing 10 mg/cu.m. of dinyl lowered cholinesterase activity, while inhalation of 0.2 mg/cu.m. under similar conditions enhanced cholinesterase activity. Inhalation of air containing 10 and 0.2 mg/cu.m. by rats increased the number of leucocytes and decreased the number of lymphocytes. Chronic 24-hour inhalation by rats of air containing 0.01 mg/cu.m. of dinyl vapor for a period of 70 days had no effect on the rats' functional activities noted in rats inhaling air having higher dinyl vapor concentrations. The limit of average 24-hour dinyl vapor concentration in atmospheric air could be the same as the limit of maximal single concentration, i.e. 0.01 mg/cu.m. Sanitary clearance zones surrounding capronic plants which discharge up to 6 ton of dinyl per month should not be less than 800 m wide.

06323

R. A. Goldbeck, J. H. Kaeding, W. E. Feroglia

ODOR CODING FOR MALFUNCTION DETECTION AND DIAGNOSIS. Philco Corp., Palo Alto, Calif., Western Development Labs. (Rept. AMRL-TR-66-122.) (Aug. 1966). 54 pp. 643239 CFSTI, DDC: AD 643239

The use of the olfactory sense for detecting and diagnosing malfunctions in equipment systems has been investigated. The literature on olfaction is reviewed and the data and data gaps relevant to equipment maintenance applications are summarized. With the literature findings as a point of reference, performance requirements for an odor-coding system are established and a taxonomic structure is synthesized for the purpose of developing specific odor-coding systems. A survey of equipment system applications leads to the conclusion that odor-augmented maintenance displays are both feasible and practical. Recommendations are made for a program of research and development leading to broad scope implementation of odor coding for malfunction detection and diagnosis. (Authors' abstract)

07091

Romano, A. H., and R. S. Safferman

STUDIES ON ACTINOMYCETES AND THEIR ODORS. (J. Am. Water Works Assoc.) 55(2):169-176, Feb. 1963.

A study was initiated to characterize the odoriferous materials produced by actinomycetes and to evaluate the effectiveness of various treatment procedures. Although the chemical structures of the odoriferous concentrates are yet unknown, these preliminary studies demonstrate the extreme intensity of the actinomycete odor, and also provide materials for assessing the efficiency of various water treatment methods. All evidence obtained thus far merely implicates the actinomycetes as a source of earthy odors in water supplies. Consequently, further chemical studies would be most desirable as a means of firmly establishing whether these troublesome odors are in fact due to actinomycetes. When odoriferous concentrates obtained from S. griseoluteus were treated with chlorine, no enhancement of the odor was noted; instead slight decreases in odor intensity could be shown. On other hand, activated carbon at a concentration of 10 ppm proved highly efficient in reducing the odors. Whether similar results will occur with other actinomycete groups still remains to be seen. The addition of 1ppm chlorine to spore suspensions of four different actinomycete species buffered at pH7.5 was found to be effective in preventing their development. It is conceivable then that chlorine could be of consequence in indirectly controlling actinomycete odor problems. ASM

07821T

Gilgen, A. and H. U. Wanner

THE TOXICOLOGICAL AND HYGIENIC SIGNIFICANCE OF OZONE. ((Die toxikologische und hygienische Bedeutung des Ozons.)) Arch. Hyg. Bakteriol. (Munich), 150(1-2):62-78, 1966. 62 refs.

The toxicological and bactericidal properties of ozone are reviewed. The acute toxicity of ozone to laboratory animals is reported as being diverse and variable from species to species. Chronical exposure results in damage to the respiratory organs, i.e., in bronchitis and lung emphysema, limitation in weight increase of young animals and reduced urine acidity. When man is exposed to 4 to 5 ppm, a lung edema develops within a few hours. Lower concentrations primarily affect respiration by irritation and cause headaches and nausea. In animals, the exposure to low ozone concentrations produces immunity to subsequently applied lethal doses. Tolerance to ozone has also been brought about by germanium oxide. Conversely, ozone has been shown to produce tolerance for ketene, H2O2 and NO2. The mode by which ozone becomes biologically effective is not yet fully elucidated. Presumably free radicals causing oxidation processes are formed, similar to those produced by nuclear radiation. These processes, in turn, set free adrenalin, noradrenalin and bradykinin. The strongest bactericidal effects of ozone are obtained at high relative humidity and low temperature. In practice the germicidal effect of ozone can only be applied to sterilizing water. The deodorizing effect is generally accepted but requires concentrations exceeding the maximum allowable concentrations.

09659

Thomas Lindvall

EXPERIMENTAL TECHNIQUES OF ORGANOLEPTIC ODOR MEASUREMENT. In: Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping, Sanibel Island, Fla., April 28, 1966. E. R. Hendrickson (ed.), Sponsored by: Public Health Service, National Council for Stream Improvement, and University of Florida. DeLand, Fla., E. O. Painter Print- ing Co., ((1966)), p. 358-364.

There is a good deal of variation between the thresholds reported in the literature for different odorous sulfur compounds. The question is why? This problem and some of the aspects of the techniques of organoleptic odor measurement are discussed. An individual's reactions to exposure in organoleptic psychophysical studies are influenced by biological, physical, socio-economic and subjective factors. Adaptation is another important phenom- enon that is often involved in these studies. Two problems connected with threshold tests are: (1) what principle is to govern the choice of stimuli and, (2) How are the subject's re- sponses to be given and evaluated. There seem to be two altern- ative forms of response; one is the yes/no response, and the other is the principle known as forced choice. The question of how pre- vious hydrogen sulfide determinations differed with respect to method is discussed. It is finally concluded that different methods do produce very different thresholds. Far too little is known about what these differences really signify for practical applications. Even within the laboratory much remains to be studies before it can be stated with any precision, what it is that is measured by odor tests, what conclusions may be drawn from the results and how far these can be generalized. A model program for the laboratory side of practical odor research is suggested.

11476

Andreeshcheva, N. G.

THE EFFECTS OF CERTAIN AROMATIC HYDROCARBONS IN THE AIR. ((O sanitarno-toksikologicheskoi otsenke nekotorykh aromaticheskikh uglevodorodov v atmosfernom vozdukhe.)) Hyg. Sanit. (English translation of: Gigiena i Sanit.), 33(4-6):13-17, April-June 1968. ((10)) refs. CFSTI: TT 68-50449/2

A spectrophotometric method of determining meta-nitrochlorbenzol (MNCB), and 3,4-dichloraniline (3,4-DCA) in the air is elaborated. The findings point to a definite relation of the threshold values of smell to the changes in the chemical structure of the substance due to introduction of nitro-amino- and chlorine groups into the benzol ring. The action of chlorine products on the light sensitivity of eyes becomes stronger as additional chlorine groups, besides the nitro- and amino-groups, are being introduced into the benzol ring.

19599

Moulton, David G.

AN ANALYSIS OF ODOR INDUCED ACTIVITY IN THE OLFACTORY SYSTEM (FINAL REPORT). Pennsylvania Univ., Philadelphia, Monell Chemical Senses Center, Grant AF-AFOSR-1056-67, AFOSR 69-2633TR, 19p. 1969. 14 refs. CFSTI, DDC: AD 695976

Analyses were made of single unit activity in the olfactory epithelium and bulb of the rat and goldfish. In goldfish, results from testing with food extracts and other compounds indicated that if low concentrations of appropriate stimuli are used, inhibition is less prevalent in the olfactory bulb than studies with higher concentrations of inappropriate stimuli might suggest. In experiments with rats, using a glass/teflon olfactometer, electronic apparatus for recordings from the olfactory epithelium, and a variety of odorants, results indicate that the evoked potentials show a progressive activity change during odor stimulation which has a clear relation to the quantity of the odor and possibly some relation to odor quality. The threshold is apparently changed at an active site by an odorant and its change is closely linked to the coding mechanism for odor discrimination at this primary center. In addition to these studies, telemetry devices and techniques were developed for recording neural impulses from freely-moving animals. In conjunction with the use of these devices, behavioral techniques were also developed for training rats and rabbits in odor detection or discrimination tasks which focus the animals' olfactory equipment on the rest odor and allow the resulting odor-induced activity to be recorded, in the form of single units, from chronically implanted microelectrodes.

20969

Frey, Allan H.

ELECTRICAL CHARGE DISTRIBUTION AND OLFACTORY METHODOLOGY AND THEORY. Psychol. Bull., 69(6):390-395, 1968. 23 refs. CFSTI, DDC: AD 674227

The static electrical charge on the subjects, equipment, walls, and odorant have had an effect on the results of a number of olfactory experiments. The nature of airborne charge complexes is considered, together with their biological effects and methodology for the measurement and control of this variable. Experimenters should consider the following procedures: all subjects should be electrically grounded; human subjects should wear only cotton clothing, and some consideration should be given to washing animal subjects in an antistatic solution; all subjects should be in a Faraday cage, or part of it; and measurement should be made and reported of the charge on the odorant, which can be done by using a Beckett probe. The olfactory epithelium is a sheet of special sensory cells with very thin cilia protruding into the overlying mucous layer, and these cilia and the membrane can be affected by charge complexes. The finding that all the physiological effects of a positive carbon dioxide ion on the trachea can be duplicated by the intravenous injection of 5-hydroxytryptamine further suggests some reason for considering the possibility of chemical change in the olfactory epithelium as a function of the charge on the odorant. Other factors for consideration result from the hypothesis that negative ions modify brain 5-HT levels causing a tranquilization effect, and that X-radiation of animals has a behavioral effect which is mediated by the olfactory system.

21125

VDI (Verein Deutscher Ingenieure) Kommission Reinhaltung der Luft, Duesseldorf, Germany

PERMISSIBLE CONCENTRATIONS OF NITROUS GASES. (Maximale Immissions- Konzentrationen MIK Nitrose Gase). VDI (Ver. Deut. Ingr.) Richtlinie, no. 2105, May 1960. 24 refs. Translated from German. 9p. 1962.

The Permissible Emission Concentrations, (PEC values) set by VDI are defined as those concentrations of pollutants in layers of the open air close to the ground which may be considered harmless, according to current knowledge, to man, animal, or plant during exposure of a given frequency and duration. These values are valid only within certain ranges, only when the pollutant occurs by itself rather than in mixture with other pollutants, and only for the open air outside of an emitting location. Nitrous gases occur in nature from electric discharges in the atmosphere; technologically, they are produced from such principal sources as the manufacture and processing of nitric acid and from internal combustion engines, explosives, and celluloid. Nitrous gases, which are recognizable by their brown color and characteristic odor, comprise the following nitrogen oxides and their compounds: nitrogen monoxide (NO); dinitrogen trioxide (N_2O_3); nitrogen dioxide (NO_2); and dinitrogen tetroxide (N_2O_4). The latter two are the primary carriers of the toxic action of nitrous gases. The PEC half-hour mean value set for continuous exposure to NO_2 is 0.5 cm^3/m^3. The PEC for intermittent exposure (permissible excess above the PEC for continuous exposure) is 1.0 cu cm/cu m half-hour mean value, three times daily. In the transition from normal air into an atmosphere containing NO_2, the olfactory threshold lies at 0.1 cu cm/cu m (calculated as NO_2) and the odor becomes characteristic at 0.5 cu cm/cu m, although within 5-6 min olfactory perception disappears even at 20 cu cm/cu m. Minor symptoms of irritation such as dry and rough throat may occur under prolonged inhalation of 1-2 cu cm/cu m; with repeated exposure, these become less and finally disappear even after inhaling 20 cu cm/cu m for 2 hrs. Toxic effects of nitrous gases on man and animals have not been differentiated; in plants, it appears that even sensitive plants sustain no damage from exposure to a mean concentration of 1 to 2 cu cm/cu m.

21359

Gesteland, Robert C.

CHEMICAL RANGING AND TRACKING. (FINAL REPORT). Northwestern Univ., Evanston, Ill., Dept. of Biological Sciences. Army Research Office, Grant DA-ARO-D-31-124-G991, Proj. 20061102A328, Rept. 7823.1-RT, 54p., July 31, 1969. 28 refs. CFSTI, DDC: AD 698581

Significant advances in understanding the chemical basis of the olfactory receptor mechanism, and in relating the signalling parameters of nervous activity to receptor stimulation, have been made. A comparative histological study has turned up a vertebrate nose with very large receptor cells, which should allow the monitoring of cell function with intracellular microelectrodes for the first time; several methods have been developed for using an electrochemical cell as an indicator of the presence of trace contaminants in a flowing stream. Based on the consensus of recent literature, all cells in the Necturus olfactory epithelium are of the order of 30 times larger in volume than those in the frog olfactory region, making Necturus a good candidate for intracellular recording. The receptor sites for odors in the olfactory mucosa are probably proteins and/or the permeability change producing the electro-olfactogram involves protein components of the membrane. It is possible that stimulus molecules are strongly bound upon reaching the receptors and are removed only by a very long time-constant biochemical process, for instance sloughing or readsorption of the stimulus molecule bound to a macromolecular component of the membrane or a very slow removal of the stimulus molecule from the membrane binding substance. It may be that chemo-reception in the frog's nose is an irreversible process and requires synthesis of new receptor sites to replace those used up by reaction with the incoming stimulus. Use of the high sensitivity cf the polarized electrode is still being investigated to trace impurities to detect the presence of contaminants in solution in a sampling cell, and most of the work completed is concerned with cell design and measurement techniques. (Author abstract modified)

21712

Neuhaus, Walter and David M. Goldenberg

VEGETATIVE REACTIONS AFTER OLFACTORY STIMULATION. (FINAL TECHNICAL REPORT). Erlangen-Nuremberg Univ., Erlangen (W. Germany), Medizinische Klinik mit Poliklinik, Contract DA-91-591-EUC-4014, Proj. 2NO61102B71D, 8p., July 1969. 14 refs. CFSTI, DDC: AD 697162

Galvanic skin resistance, arteria radialis pulse and blood pressure, respiration, and stomach motility were recorded electrochemically in man after olfactory stimulation. In most cases, skin resistance decreases rapidly and returns gradually to its original value, frequently with temporary decrements in between. Arteria radialis pressure often shows a decrease, followed by a wavy pattern of alternate increments and decrements, before returning to its original value. Pulse frequency and amplitude are hardly affected. Respiration often becomes deeper during stimulation with pleasant odors, while its amplitude decreases with unpleasant odors; however, a partial increase of the respiratory amplitude with unpleasant odors was observed in some cases. Stomach motility generally increases in the form of increased amplitude of contraction, persistent contraction, or increased frequency of contraction. The largely autonomous cycles of the parameters investigated are concluded to be affected by olfactory stimuli, the effects depending on the particular conditions prevailing in the autonomic nervous system at the time of stimulation. (Author summary modified)

23298

Alpert, Stephen, Barry B. Schwartz, Si Duk Lee, and Trent R. Lewis

ALVEOLAR PROTEIN ACCUMULATION: A SENSITIVE INDICATOR OF LOW-LEVEL OXIDANT TOXICITY. Preprint, Public Health Service, Cincinnati, Ohio, National Air Pollution Control Administration, 19p., 1970. 10 refs.

Studies of the response of low doses of edemagenic gases have been hampered by the insensitivity and the nonquantitative nature of the major indicators of response. A new and more sensitive indicator, the recovery of I 131-albumin from the alveolar spaces six hours after its intravenous injection in rats was applied. Significantly increased albumin recovery was found for all concentrations of ozone at and above 0.5 ppm. No wet changes were noted below 2.5 ppm ozone, and there was no consistent histological finding except for slight sloughing of bronchial epithelium at 2.5 ppm. Application of these methods to studies of steroid effects revealed increased sensitivity to ozone following administration of methylprednisolone. In addition, animals treated with steroids and prior to exposure to 0.25 ppm ozone became tolerant to subsequent ozone challenge, while animals given pre-exposure but no steroids did not. (Author abstract modified)

27137

Tisi, Gennaro M., Anthony J. Cuomo, and Kenneth M. Moser

AIR POLLUTION AND RESPIRATORY DISEASE. In: Project Clean Air. California Univ., La Jolla, Pulmonary Div., Vol. 2, App.-B, p. B-1 to B-10, Sept. 1, 1970. 28 refs.

The limitations of recent epidemiologic, pathologic, and physiologi studies of the health hazards of air pollution are noted. Although evidence has been obtained suggesting that prolonged exposure to pollution can increase morbidity and mortality in persons with pre-existing bronchitis and emphysema and possibily cause obstructive airways diseases, the specific pollutants involved and the mechanisms by which they impair respiratory function have received limited attention. Future studies should attempt to separate the role of gaseous vs. particulate pollutants and consider the effects of interacting factors such as age, sex, socioeconomic class, occupational exposure, migration, and smoking habits on cardiorespiratory diseases. Several specific research projects needed to resolve the specific air pollution problems of California are listed.

28175

Ogata, Masana, Katsuaki Okuma, Junko Omori, and Suzuko Ueki

THE RESULTS OF THE INVESTIGATION OF ODORS IN MIZUSHIMA DISTRICT. (Mizushima-chiku ni okeru akushu chosa seiseki). Text in Japanese. In: An Outline of Countermeasures Against Public Nuisance in Kurashiki City. (Kurashiki-shi ni okeru kogai taisaku no gaiyo). Kurashiki Municipal Office (Japan), Dec. 1968, Chapt. 6-(12), p. 144-155.

Complaints about odors in the Fukuda, Tsurashima, Mizushima and Kojima districts of Kurashiki City (Okayama Prefecture) were investigated by means of questionnaires sent to families of junior-high schoolboys. In addition, measurements of ammonia and organic matter in air and water were carried out in the first three districts. The rates of complaints were 6.0% for the Fukuda district, contiguous to factories, 4.6% for the former Kurashiki City, and 4.3% for the Mizushima district. In the Tsurashima district, 32.24% of the complaints centered on one odor. In all districts, more than 10% of the respondents complained about the odor of gases, ammonia, gasoline, vinegar, rotten onions, burning matches, and burning rubber. On one day ammonia concentrations in Fuduka ranged from 0.11 ppm to 0.25 ppm. In increasing odor of frequency, subjective symptoms were headache, sore throat, eye irritation, coughing, and nausea, Organic matter found in Mizushima was observed in all water basins.

34667

Little (Arthur D.), Inc., Cambridge, Mass.

EVALUATION OF COMMUNITY ODOR EXPOSURE. 31p., 1971. 58 refs. (Report resulting from discussions and based on the working papers of a symposium sponsored by the Environmental Protection Agency, April 26-29, 1971.) NTIS: PB 204989

Discussions on community odor exposure during a symposium are summarized, based on papers and reports by the participants on human reactions to odors; empirical data on odor exposure from different sources; dose-response relationships; interactions between odor sources and environmental conditions; temporal patterns; and scientific bases for performance standards. Recommendations for basic and applied research are presented. Odorous compounds were defined as those materials whose most common adverse effect is the annoyance reaction caused by the odor itself. Human reactions to odors included disease states, annoyance reactions, social and economic reactions, physiological responses, and interference with positive reactions to nonambient odors. Sensory analysis techniques to determine odors from pulp mills and diesel exhaust are discussed.

34686

Henschler, D., A. Stier, H. Beck, and W. Neuman

OLFACTORY THRESHOLD OF SOME IMPORTANT IRRITANT GASES AND MANIFESTATION IN MAN BY LOW CONCENTRATIONS. Arch. Gewerbepathol. Gewerbehyg., 17(6):547-570, March 9, 1960. 48 refs. Translated from German. 32p.

An investigation was conducted to determine olfactory threshold and symptoms resulting from the one-half hour exposure of human subjects to different concentrations of sulfur dioxide, ozone, and nitrogen dioxide. The experimental arrangement is described. Sulfur dioxide in these tests was smelled and/or tasted in some cases at 0.5 ppm, in 75% of the cases at 1.0 ppm, and always at 2.5 ppm, while 5.0 ppm produced coughing. The olfactory threshold for ozone lies below the lowest tested concentration of 0.02 ppm. Nitrogen dioxide is smelled in part at 0.1 ppm, and always starting at 0.4 ppm.

35570

GUIDES FOR SHORT-TERM EXPOSURES OF THE PUBLIC TO AIR POLLUTANTS. II. GUIDE FOR HYDROGEN CHLORIDE. National Academy of Sciences, National Research Council, Washington, D. C., Committee on Toxicology, Air Pollution Control Office Contract CPA 70-57, 15p., Aug. 1971. 31 refs. NTIS: PB 203464

At sufficiently high concentrations, hydrogen chloride acts as a primary irritant, especially to the eyes and the moist mucous membranes of the respiratory tract. Effects of exposures of animals to HCl are cited, as well as the physiological responses of man to HCl. Although concentrations between 75 and 150 mg/cu m have been reported to be tolerable for periods up to one hour, inhalation of 1500 mg/cu m is dangerous within one hour. Odor thresholds are indicated, including the threshold of injury for plants. Short-term and emergency exposure limits are recommended. Effects on materials are mentioned, and analytical methods are described.

35671

Eglit, M. E.

BIOLOGICAL ACTION OF LOW CONCENTRATIONS OF OZONE. (Biologicheskiye deystviya malykh kontsentratsiy ozona). Text in Russian. Aktual Voprosy Gig. Truda Prof. Patol., Mater. Konf., 1st 1967, p. 77-80. 6 refs.

Investigation of the biological activity of low concentrations of ozone showed that ozone affects the human organism when present in concentrations of .01 mg/cu m and above. The lowest concentration causing olfactory sensation in sensitive persons participating in the experiment was .015 mg/cu m, while the lowest concentration having an effect on the electric activity in the brain was .01 mg/cu m. A specific spectrophotometric method for determination of atmospheric ozone concentrations with the aid of dihydroacridine is described. The sensitivity of the method is .0042 micrograms per ml. The effect of ozone concentrations of .11-.0054 mg/cu m on white rats was studied after 93 days of continuous exposure using Physiological, biochemical, and other techniques. A concentration of .11 mg/cu m caused pathologic changes in the lungs, kidney, spleen, heart, and brain.

H. EFFECTS-PLANTS AND LIVESTOCK

00252

DEADLY GASES IN PIGGERIES. Ger. Res. Serv. 5. (5) 9, May 16, 1966.

Manure pits situated below slotted floors should be safeguarded by slides and odor barriers. Gases develop from ammonia and hydrogen sulfide which remain harmless even after prolonged periods of manure storage can become dangerous to life, if the manure is agitated prior to being pumped off. Dissection findings on a group of pigs which died in a pig-sty showed death was caused by poisoning by waste gas. In cases where slides and odor barriers are not available, animals should be taken out in the open before the manure is agitated, and pig-sties aired well before being reentered.

20028

LeBlanc, Fabius and D. N. Rao

REACTION OF SEVERAL LICHENS AND EPIPHYTIC MOSSES TO SULFUR DIOXIDE IN SUDBURY ONTARIO. (Reaction de quelques lichens et mousses epiphytiques a l'anhydride sulfureux dans la region de Sudbury, Ontario). Text in French. Bryologist, vol. 69:338-346, 1966. 11 refs.

Circular bark plugs 4.8 cm in diameter were cut from country roadside trees bearing 19 species of lichens and mosses, and forty-two plugs were transplanted in the summer of 1964 onto trees in Sudbury, Ontario, where the atmosphere is heavily polluted with sulfur dioxide. Most of the transplanted lichens and mosses were dead or greatly damaged in October of 1965. The lichens Bacidia chlorococca and Parmelia sulcata were the species most tolerant of the contaminated atmosphere. (Author abstract)

I. EFFECTS-MATERIALS

05463

K. Toishi and T. Kenjo

ALKALINE MATERIAL LIBERATED INTO ATMOSPHERE FROM NEW CONCRETE. J. Paint Technol. 39, (506) 152-5, Mar. 1967.

Because of the interest in the damage to certain materials from the odor-producing substance present in the air of newly construc- ted concrete storage rooms, an investigation was made of the air contaminant. There is present in the vicinity of fresh concrete a detectable amount of alkalinity that can hasten the deterioration of certain materials such as art objects, silk, hardened linseed oil, leather, pigments and dyes. Spectrographic analysis of material collected from the air shows a composition similar to that of concrete. If the walls are covered with varnish, the deterioration from the alkalinity will be minimized. Natural ag- ing or neutralizing of the surface layer of the concrete wall with air must be in a highly-dispersed state approaching molecular dimensions.

19325

Konda, Kiyoshi, Hisao Ito, and Atsuhiro Honda

FIELD EVALUATION OF EXHAUST GAS FROM REFUSE INCINERATOR RELATED TO AIR POLLUTION AND METAL CORROSION. Trans. Soc. Heating, Air-Conditioning, and Sanitary Engrs. (Japan), vol. 7:95-104, 1969.

A study of municipal incinerator exhaust gas composition conducted at five sites in Japan is described. The study was undertaken to obtain information on odor and metal corrosion problems. The exhaust consisted of sulfur oxides, nitrogen oxides, ammonia, sulfuric acid, nitric acid, organic acids, and hydrochloric acid. Volatile organic acids and hydrochloric acid are mainly responsible for the corrosion, with sulfuric and nitric acids only partially concerned. Percentages of exhaust products as a function of raw refuse input are tabulated. Continuous firing rather than batch firing would limit noxious effluents. Temperature and excess air control would also help. After-burning chambers should be installed to further reduce contaminants.

24187

MAINTENANCE OF ODOR-CONTROL SYSTEMS. Environ. Control Safety Management, 1970:58-59, Oct. 1970.

Material failures in odor control systems can do more than result in costly downtime for maintenance, repair, or replacement of plant equipment. While not harmful to health, odor is annoying and can affect community relations. To prevent odor during fermentation from being vented into the atmosphere, engineers at a pharmaceutical company producing antibiotics devised a system for conducting the fumes of the fermentation facilities to the power plant for incineration. They discovered, however, that the system' fans and ductwork were subjected to moderately heavy pitting and corrosion, which resulted from warm moist particulate matter being picked up from the fermenting tanks and carried in the airstream. The first step in controlling the old system was to specify a more corrosion-resistant material for the ductwork and fans. Type 316 stainless steel was specified, containing 16-18% chromium, 10-14% nickel, and 2-3% molybdenum. The replacement ducts were made from 16-gauge stainless steel sheet, and four-foot-long duct sections were butt-welded together into eight-foot lengths. These longer sections were joined during installation with simple flanged joints sealed with a silicone material.

J. EFFECTS-ECONOMIC

16457

Julson, J. O.

ENVIRONMENTAL PROTECTION - HOW MUCH WILL IT COST YOUR MILL? Pulp Paper, 43(4):152-153, April 1969.

The cost of protecting the quality of the air against kraft mill odors, bleach plant gaseous emissions, particulates, soot, cinders, incineration of mill refuse, and water protection was discussed. Digester blow and relief gases are readily collected and can be thermally oxidized in a special furnace, lime kiln, or recovery furnace. Odor reduction was impressive and estimated capital cost was $125,000-$150,000 (1969). Turpentine should be condensed out of digester relief gases to take advantage of income generated through its sale. Black liquor oxidation is also effective in odor reduction and saves in chemical costs. Cost estimates ranged from $165,000 for a 200-ton mill to $240,000 for a 1000-ton mill. Particulate emission standards of 0.10 grains/standard cu ft of stack gas were obtained with precipitators. Capital costs for 99% efficiency ranged from $375,000 for a 200-ton mill to $1,087,000 for a 1000-ton mill. Costs for cyclone scrubbers and lime kiln scrubbers were considerably less. Capital costs for the trapping of chlorine and chlorine dioxide emissions by scrubbing in a caustic solution and returning the resulting solution back to the bleaching process ranged from $35,000 for a 200-ton mill to $155,000 for a 1000-ton mill. The installation of precipitators for soot and cinder control was estimated to cost $1.50/cu ft/min for 99% efficiency. The cost estimates of incineration of mill refuse ranged from $3400 for 50 lb/hr to $38,200 for 2000 lbs/hr. The costs of primary treatment, secondary treatment, and sludge incineration for water protection were also estimated. Capital and operating budgets will have to provide for these heavy added costs.

29299

Mueller, James H.

WHAT IT COSTS TO CONTROL PROCESS ODORS. Food Eng., 43(4):62-65, April 1971.

The accepted and recognized method of controlling organic fumes and odors is to raise the process exhaust to 1400 F for 0.5 sec. The three types of equipment that can meet this requirement are compared with reference to total annual cost, factors influencing total cost, and heat recovery efficiency. The types are afterburner; afterburner with heat exchange; and thermal regenerative air purification system (TRAPS). While initial equipment cost is low, total annual costs of an afterburner are $202,510 in contrast to $119,090 and $69,620 for afterburner with heat exchange and the TRAPS system, respectively. A major factor in the additional annual costs of an afterburner is the very high fuel cost ($181,000).

34518

Greene, C. H.

POLLUTION COSTS. Natl. Eng., 75(11):8, Nov. 1971. (Presented at the American Institute of Plant Engineers, Pollution Conference.)

According to a survey conducted in approximately 3000 manufacturing plants, the leading water pollutants are acid and alkali, settleable solids and oil. Favorite types of air quality treatment equipment include wet scrubbers (38%), fabric filters (33%), and mechanical collectors (31%). Electrostatic precipitators and incineration devices are also used. Estimates of the breakdown of pollution expenses are tabulated. Odors, particulates, and sulfur dioxide are chief air problems.

K. STANDARDS AND CRITERIA

00157

Maga, John A. and John R. Kinosian

MOTOR VEHICLE EMISSION STANDARDS - PRESENT AND FUTURE. In. Vehicle Emissions, Part II, SAE Progress in Technology Series, Vol. 12, New York, Society of Automotive Engineers, Inc., 1966, p. 297-306. 10 refs. (Presented at the SAE Automotive Engineering Congress, Detroit, Mich., Jan. 10-14, 1966.)

In California, the State Dept. of Public Health has established motor vehicle emission standards for exhaust hydrocarbons, carbon monoxide and smoke; for fuel tank and carburetor evaporative losses; and for crankcase hydrocarbon emissions. The data on which the standards are based and the need for improved measurement procedures are discussed. At this time, exhaust emission standards for oxides of nitrogen and for odor are being considered as additional standards. Future standards may rate hydrocarbon emissions according to their smog potential. Another possible change that is discussed is to specify the quantity rather than the concentration of pollutants that may be emitted from the exhaust of motor vehicles.

05117

V. A. Ryazanov

ABOUT THE CRITERIA FOR EVALUATION OF EFFECTS OF ATMOSPHERIC POLLUTANTS AT LOW CONCENTRATIONS UPON AN ORGANISM . Gigienna i Sanit. 26, (6)3-7, June 1961. Russ. (Tr.)

The first attempt to develop maximum allowable concentrations of air pollutants has been undertaken by the Soviet hygienists. As a basis for this work the criteria were used which were first published in 1949 and which did not meet with any objections in the scientific literature. These criteria, in essence, are as follows: (1) 'An allowable concentration' could be only such concentration of any substance in an ambient air, which does not affect a man directly or indirectly by producing a detrimental or unpleasant effect, does not lower his working capacity, and does not affect his mood or sense of well-being; (2) The necessity of acclimatization to the toxic substances should be looked upon as an adverse condition and a proof of untolerable concentration; and (3) The 'untolerable concentrations' are also such concentrations of toxic substances, which have a damaging effect upon vegetation, climate of a location, visibility or customary conditions of life of the residents. Therefore, during the investigations in regard to hygienic regulation of atmospheric pollution, a special attention has been paid to a threshold of odors. These investigations, however, showed that an absence of odor perception does not indicate that under the influence of an action of unperceived concentration there is no occurrence in an organism of some reflex reactions with the receptors of the respiratory system. As a rule, the higher concentrations of odoriferous gases cause a decrease in light sensitivity, while the lower concentrations increase it. These changes were interpreted in regard to relationship between nerve centers. When, under an influence of weak odor, a process of excitation takes place in a sensory center it reaches the visual region by way of irradiation over the brain cortex and induces an increase in light sensitivity. If an odor is strong, an excitation which appears in olfactory center, according to a law of negative induction, causes an inhibition of the visual region of the cortex and as a result its light sensitivity is reduced.

05947

Feldman, Yu. G.

ACETONE AS AN ATMOSPHERIC AIR POLLUTANT. (In: Limits of [illegible]able concentrations of atmospheric pollutants, Book 6.) U.S.S.R. Literature on Air Pollution and Related Occupational Diseases, Vol. 9, pp. 62-72. (1962). Russ. (Tr.)

It was found in this study that 1.1 mg/cu m is the concentration of threshold acetone vapor odor perception in most sensitive persons, and that 0.8 mg/cu m is the odor nonperceptible concentration. 0.55 mg/cu m is the concentration of threshold acetone reflex effect on the functional state of celebral cortex, as determined by the adaptometric method. 0.44 mg/cu m is the subthreshold concentration. The concentration of threshold acetone reflex effect on the formation of electrocortical conditioned reflexes is 0.44 mg/cu m, and the maximal inactive concentration is 0.35 mg/cu m. Chronic inhalation of an average acetone vapor concentration of 199 mg/cu m, 8 hours daily for 45 days produces motor chronaxy changes in the experimental animals. Continuous 45 day inhalation of an average acetone vapor concentration of 0.53 mg/cu m produces no clearcut changes in the animals motor chromaxies. Motor chronaxy curves of the control animal are practically identical with those noted in experimental animals which inhaled 199 mg/cu m and also 0.53 mg/cu m of acetone vapor uninterruptedly for 45 days. This is also true of the blood picture, of the animal0s weight, and histologic pictures of the internal organs. The limits of allowable single and average 24-hour concentrations should not exceed 0.35 mg/cu m. The atmospheric air in the vicinity of the investigated acetate silk plant is systematically polluted with acetone, the concentrations of which exceed the recommended allowable limit even at 600 m from the plant. The 100 m sanitary clearance ozone established for acetate silk producing plants is inadequate and should be increased to 750 m, especially where the acetone discharge averaged 4.5 tons per day.

07766

Missouri Air Conservation Commission, Jefferson City

AIR QUALITY STANDARDS AND AIR POLLUTION CONTROL REGULATIONS FOR THE ST. LOUIS METROPOLITAN AREA. Preprint, 46 p., Feb. 22, 1967.

Allowable maximum average concentrations for various periods of time are listed for major pollutants such as SO2 and suspended particulates. Among the topics covered in the 24 regulations are: Restriction of Emission of Particulate Matter from Industrial Processes; Open Burning Restrictionsestriction of Emissions of Sulfur Dioxide from Use of Fuel; and Control of Odors from Processing of Animal Matter.

11734

Maga, John A.

CONSIDERATIONS IN ESTABLISHING AMBIENT AIR QUALITY STANDARDS. J. Occupational Med., 10(8):408-413, Aug. 1968.

Some of the factors to be considered in the establishment of air quality standards by the U.S.P.(.S. or state and local governments are the purposes and uses of such standards, the degree of understanding regarding the effects of pollutants on the environment, and the existence of usable data on the concentration of contaminants in the ambient air. A distinction is drawn between air quality standards and air quality criteria on which they are based, as well as between air quality standards and emission standards which serve as the direct basis for control. It is pointed out that ambient air quality standards are generally much lower than threshold limit values for occupational exposure, and that careful attention must be paid to the relationship between effects of air pollutants and concentration. An air monitoring program is an essential part of any developmental work towards the establishment of air quality standards. Among the potential effects to be taken into consideration are those on human health, vegetation and livestock; irritation to the senses, and impairment of visibility; soiling, unpleasant odors and other esthetic effects. The experience of the State of California in the establishment of air quality standards is briefly reviewed, with emphasis on the three-level approach ('emergency', 'serious', and 'adverse' levels) and the 'oxidant index'.

15926

AIR POLLUTION CODES - HERE'S LATEST PICTURE. Roads Streets, 113(1):104, 106-107, Jan. 1970. 5 refs.

Regulations currently in effect that are used by air pollution control agencies to control emissions from asphalt batch plants were described. Nine of 38 states have specific regulations for asphalt plants. These regulations include particulate matter and smoke, but do not include odors or other pollutants. The regulations of four states and one local agency are based on the amount of pollution emitted per 1000 lb of flue gas discharged from the stack. Two of the states base their regulations on a process weight table, and require a specified collection efficiency of control equipment. Still another state bases its regulations on a concentration standard and a buffer zone. And one state uses only a buffer zone to control emissions. The other 29 states and five local control programs have regulations applicable to all industrial processes and apply them to asphalt plants. Most of these states use process weight tables for the control of particulate matter. Many also have regulations that visible emissions must not exceed No. 2 on the Ringlemann Scale or equivalent opacity. Nine of the states employ a standard for odor control. Although most of the regulations are written in general terms, one state stipulates the use of a scentometer for odor measurements.

16263

Ludwig, John H.

SEMINAR ON AIR POLLUTION BY MOTOR VEHICLES. Preprint, Assistant Commissioner, Science and Technology, Washington, D. C. 64p., 1970. 27 refs.

The contribution of motor vehicle emissions to community-wide air pollution problems depends on several related factors: the extent of community, commercial, and industrial sources as compared to vehicle sources; the size of the community and the distribution of these sources; topographical and meteorological factors; and the degree of control exercised for sources. The relative importance of motor vehicle emissions can be approached by evaluating specific effects, specific pollutants, and sources with respect to pollutant emissions of all types. Average emissions by sources are presented for Los Angeles County, Louisville, Detroit, and 11 Pennsylvania counties. Sources of gaseous emissions from motor vehicles are reviewed, as well as the sources of hydrocarbon and smoke emissions from diesels. California standards are reported for vehicle smoke and odor emissions, carbon monoxide, and nitrogen oxides levels. Also reported are 1970 Federal Standards for exhaust emissions from automobiles and light trucks. An attempt is made to assess specific hydrocarbon constitutents in gasoline engine exhaust, crank case ventilation, and evaporation losses, and diesel exhausts and their relationship to photochemical reactions occuring in the atmosphere. The need of continued laboratory research and detailed examination of exhausts produced by control devices is stressed.

18294

Gerhardson, G.

EXHAUST GASES FROM GASOLINE POWERED VEHICLES. (Avgaser fran bensindrivna bilar.) Text in Swedish. Kommunikationsdepartmentet ledningsgrupp rorande utvecklingsarbete pa bilavgasomradet, 112p., 1968. 51 refs.

The investigation deals with the occurrence and effects of automotive exhaust smoke, statistical information, trends of development, emission of air pollutants from gasoline fueled automobiles, and available methods to reduce the emissions. The purpose of the survey is to supply information to the Swedish government about air pollution problems from gasoline powered vehicles. The investigation is ended with proposals for reducing the lead content of gasolines. The substances dealt with are carbon monoxide, hydrocarbons, odorous and irritating substances, oxides of nitrogen, and particulates among which lead compounds are discussed. Measurements and calculations show that the pollution level on heavily trafficked streets normally does not reach levels which cause acute health effects by the separate substances. Uncertainty exists concerning synergistic and long- term-exposure effects. Bad odor and soiling are evident inconveniences from auto exhaust gases. Photochemical smog, however, has not occurred in Sweden. The suggested standards by the Guidance Group are 45 grams of carbon monoxide and 2.2 grams of hydrocarbons per dilometer. Corresponding average values are 30 grams carbon monoxide and 1.5 grams of hydrocarbons per kilometer, which means that the emissions will be reduced by about 40 per cent of the present level. For the model year 1973 the group considers that technical development has made it possible to tighten the standards. Sixty per cent reduction of the carbon monoxide and 50 per cent of the hydrocarbons should then be possible. After two more years, in 1975, it should be possible to obtain 70 per cent reduction of the carbon monoxide and 60 per cent of the hydrocarbons.

20194

Chzhen-tsi, Chzahao

BASIC EXPERIMENTAL INFORMATION FOR THE DETERMINATION OF THE LIMIT OF ALLOWABLE METHANOL CONCENTRATION IN ATMOSPHERIC AIR. In: Limits of Allowable Concentrations of Atmospheric Pollutants. V. A. Ryazanov (ed.), Book 5, Washington D. C., U. S. Public Health Service, March 1962, p. 67-78. 14 refs. (Translated by B. S. Levine.)

Studies were conducted of the presence and effects on rats and humans of methanol as an atmospheric pollutant.

Methanol vapor concentration was determined by a method based on methanol oxidation to formaldehyde by means of potassium permangante in phosphoric acid medium. It was found that 4.3 mg/cu m of methanol vapor in atmospheric air constituted the odor perception threshold concentration for sensitive persons; 3.7 was the subthreshold concentration. The threshold methanol vapor concentration affecting eye sensitivity to light was 3.3 mg/cu m. Concentrations below odor perception threshold affected the functional state of the cerebral cortex. Exposure to 50 mg/cu m concentration 12 hr daily for 3 months brought about changes in motor chronaxy and in the ratio of flexor and extensor chronaxies. Equalization (chronaxy ratios equallized) and at times reverse chronaxy ratios occurred most frequently as a result of exposure to higher concentrations. Inhalation of 1.77 mg/cu m produced no such results. Using threshold of reflex effect on eye sensitivity to light as an index, together with the need for a safety coefficient, 1/5 mg/cu m is recommended as the MAC value for atmospheric methanol vapor. Methanol-emitting pharmaceutical and chemical plants should not be located near residential areas, and should be equipped with adequate control equipment. (Author conclusions modified)

21083

Mnatsakanyan, A. V.

BASIC EXPERIMENTAL INFORMATION FOR THE DETERMINATION OF THE LIMIT OF ALLOWABLE CHLOROPRENE CONCENTRATION IN ATMOSPHERIC AIR. In: Limits of Allowable Concentrations of Atmospheric Pollutants. V. A. Ryazanov (ed.), Book 5, Washington, D. C., U. S. Public Health Service, March 1962, p. 79-85. 13 refs. (Translated by B. S. Levine.)

Studies were made of the physiological effects of chloroprene, a highly volatile fluid emitted with other unsaturated and chlorine-substituted hydrocarbons emitted during the synthesis of rubber from acetylene. Results obtained by question and answer indicated that 0.9 mg/cu m is the threshold concentration of chloroprene odor perception for the average persons, and 0.4 for persons with sensitive odor perception. Threshold concentrations on the functional state of the visual analyzer, determined by use of an adaptometer, coincided with threshold values determined by the odor perception method. Threshold and subthreshold chloroprene vapor concentrations increased the analyzer sensitivity to light stimulation; concentrations 4 or more times greater than threshold values reduced the sensitivity. It is recommended that the maximum allowable concentration be set at 0.25 mg/cu m. Concentrations of chloroprene found in the atmospheric air surrounding a synthetic acetylene rubber plant greatly exceeded the threshold concentrations; reductions can be attained by eliminating leakages at all stages of production and by installating equipment for removing unsaturated chlorinated hydrocarbons. The l-km sanitary clearance zone now prescribed for synthetic rubber plants is inadequate; it is recommended that such plants, especially plants using acetylene as the basic raw material should be located 5-10 km from populated areas. (Author conclusions modified)

21084

Izmerov, N. F.

ATMOSPHERIC AIR POLLUTION WITH GASOLINE VAPOR AND ITS LIMIT OF ALLOWABLE CONCENTRATION. In: Limits of Allowable Concentrations of Atmospheric Pollutants. V. A. Ryazanov (ed.), Book 5, Washington, D. C., U. S. Public Health Service, March 1962, p. 52-67. 17 refs. (Translated by B. S. Levine.)

The effects of solvent gasoline vapors emitted from crude oil on conditioned reflex reactions, odor thresholds, and eye sensitivity were studied. White rats exposed to 106.5 cu m vapor concentration 6 hours daily for 5 months showed shifts in conditioned reflex activity which progressed with exposure duration, but which returned to normal two weeks after the exposure was terminated. No notable changes occurred in the cerebro-cortical activity of rats exposed to a chronic inhalation of 21.8 mg/cu m or in the control rats. Thresholds of odor perception were 10 mg/cu m for solvent gasoline; 6.5 for automotive gasoline; and 7.5 cu m for aviation gasoline. Solvent gasoline vapor began to affect reflex activity at 56 mg/cu m concentration; the threshold of reflex activity effect proved a sensitive index for determining maximum allowable concentrations. It is recommended that 5 mg/cu m of low-sulfur gasoline vapor be adopted as the MAC cu m in atmospheric air, calculated in terms of hydrocarbons. Industrial enterprises which use gasoline in ton quantities per day constitute potent sources of ambient air pollution with gasoline vapor (hydrocarbons). Sanitary clearance zones around such plants must be not less than 500 m wide. Results of air sample test analyses showed that gasoline vapor concentrations in the air 30 m from an auto repair shop were as high as 7.1 mg/cu m. It was recommended that the zone surrounding that shop be not less than 50 m. Plants which use gasoline as solvent in 2.5 ton quantities per day should have a clearance zone of not less than 300 m, and plants using up to 1.5 tons per day, 100 m wide. (Author conclusions modified)

21918

Rumsey, Donald W. and Ramon P. Cesta

ODOR THRESHOLD LEVELS FOR UDMH AND NO2. Am. Ind. Hyg. Assoc. J., 31(3):339-343, May-June 1970. 12 refs.

The odor threshold levels for unsymmetrical dimethylhydrazine (UDMH) and nitrogen dioxide have been generally quoted at 6 to 14 parts per million (ppm) for UDMH and 5 ppm for NO2. The value for UDMH is twelve to twenty-eight times the threshold limit value. Seven years of field experience by personnel of this section have indicated that the actual odor thresholds are considerably below these values. Since odor threshold levels are used by safety and operating personnel at Cape Kennedy as an indication of exposure, it was considered appropriate to evaluate this field experience. On the basis of these data and the results of some controlled studies, it was concluded that the actual odor thresholds are 0.5 ppm or less for NO2 and less than 0.3 ppm for UDMH. (Author abstract modified)

27403

MAXIMAL ACCEPTABLE CONCENTRATION OF NITROGEN DIOXIDE. American Standards Assoc., Inc., New York, Rept. Z37.13-1962, June 7, 1962. 9 refs.

The maximum acceptable concentration of nitrogen dioxide is 5 parts per 1,000,000 parts of air by volume, corresponding to 0.0094 mg pe liter at 25 C and 760 mm pressure, for exposures not exceeding a total of 8 hours daily. Short exposures of 3 to 5 minutes duration should not exceed a maximum of 25 ppm of NO2. Sampling procedures and analytical methods are mentioned, with the Saltzman method for NO2 determination recommended. The odor threshold has been stated to be 5 ppm and the visual threshold to be 75 to 100 ppm. Establishment of maximum acceptable concentration is discusse General properties, physical and toxic properties of nitrogen dioxide are indicated. All reports indicate that NO2 affects the respiratory tract, including the lungs, causing irritation and injury that may result in fatal pulmonary edema and hemorrhage if the concentration is excessive.

30870

Basmadshijewa, K., M. Argirowa, and E. Dawidkowa

HYGIENIC ESTABLISHMENT OF THE VALUE OF THE MAXIMUM CONCENTRATION OF IMMISSION FOR METHYLENE CHLORIDE IN THE AIR OF THE ATMOSPHERE. (Hygienische Begruendung des MIK-Wertes von Methylendichlorid in der atmosphaerischen Luft). Text in German. Wiss. Z. Humboldt Univ. Berlin Math. Naturw. Reihe, 19(5):469-470, 1970. 7 refs.

The short-time maximum permissible emission concentration value for methylene dichloride was sought by determining the olfactory sensitivity threshold, the reflex threshold of the eye by means of optical chronaxy, and the vascular reaction by means of finger plethysmography. The range of methylene dichloride concentrations used in the experiments involving 10 individuals was from 2.8 to 33.2 mg/cu m. The olfactory sensitivity threshold was found to be 4.1 mg/cu m for the most sensitive individuals. The visual reflex threshold was found to coincide with the olfactory sensitivity threshold, which was 2.8 mg/cu m. The reflex threshold determined by finger plethysmography was 6.5 mg/cu m, and the lower threshold was 4.1 mg/cu m. In view of these findings, a short-time maximum permissible emission concentration of three mg/cu m methylene dichloride in atmospheric air is proposed.

31286

Don, W. A.

DOBETA AND THE CLEAN AIR ACTS. Smokeless Air (London), 40(152):120-122, Winter 1969.

DOBETA (the Domestic Oil Burning Equipment Testing Association) is an independent association that tests the reliability, performance, and safety of domestic oil burning apparatuses. Every appliance submitted for DOBETA approval is tested to standards much more stringent than those specified in the Clean Air Acts. DOBETA standards specify that smoke number during continuous normal operation should not exceed a Bacharach figure of two. Performance during start-up and change of firing rate, when this figure can be exceeded, is assessed by the Smoke Index. Odors are determined by a flame ionization test. In addition to laboratory testing, DOBETA has established a factory inspection system to insure that production is in complete conformity with the model that has been tested and approved.

31516

Board of Water and Air Resources, Raleigh, N. C.

RULES AND REGULATIONS GOVERNING THE CONTROL OF AIR POLLUTION. 25p., May 13, 1971.

Rules, regulations, and standards governing the control of air pollution in North Carolina are presented. These include definitions, controls and prohibition of open burning and visible and odorous emissions, classification and registration for air contaminant sources, emission control standards and compliance with these, and ambient air quality standards. Descriptive charts are also included.

31968

Yamamoto, Norimasa

ON EMISSION STANDARD OF SMOKE (HARMFUL SUBSTANCES) BASED ON AIR POLLUTION CONTROL LAW. (Taiki osen boshiho ni motozuku baien – yugai busshitsu – no haishutsu kijin ni tsuite). Text in Japanese. Preprint, Smaller Enterprises Promotion Corp. (Japan) 72p., 1971. (Presented at the Public Nuisance Prevent. Tech. Seminar, Japan, 1971.)

Characteristics of smoke, dust collection equipment, average particulate diameter, and other factors are tabulated. The number of boilers in Tokyo, Osaka, and Kanagawa are compared. The emission standard for dust is 0.06 g/N cu m-0.20 g/N cu m for boilers and furnaces, in newly constructed installations, which utilize heavy oil as fuel. The average cadmium concentration at nine monitoring stations in 1969 was 0.020 micrograms/cu m. Environmental pollution due to heavy metals is also considered. At 0.1 ppm, the odor of chlorine can be detected with slight irritation; at three to six ppm, there is irritation of the eyes, nose, throat, and headache, while life is threatened at 14-21 ppm. Chlorine also damages plants after about 0.5 ppm. Chlorine, up to 0.5 ppm, is contained in tap water. The environmental standard should be less than 0.02 ppm. Even small amounts of fluorine in the atmosphere can damage plants, and the standard should be two to five micrograms/cu m. Above two to eight ppm of F, teeth have motley patterns, and eight to 15 mg/day for 10 years would bring about softening of the bone. Standards are also given for sulfur dioxide, carbon monoxide, oxidants, hydrocarbons, and nitrogen dioxide. Air pollution control agencies, districts, plans and alerts are mentioned.

35146

Suzuki, Takeo, Kiyofumi Ishikawa, and Hiroshi Yamamoto

DATA AND EXAMINATION FOR ESTABLISHING SULFUR OXIDES EMISSION STANDARD. (Aryusan gasu io sankabutsu no kankyo kijun settei no tame no shiryo to kosatsu). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(3):315-357, Sept. 1971. 124 refs.

The policies of the World Health Organization, the governments of the United States, West Germany, Russia, and Japan with regard to establishment of environmental standards are reviewed briefly. The actual methods of establishing standards in the United States, California, Sweden, Russia, and West Germany are discussed in more detail. The influences of sulfur dioxide and sulfur trioxide are discussed generally with regard to human respiratory systems, animal bodies, olfactory threshold, and eye damage. The effects of SO2 on human and animal health have been studied during many experiments. Some of the major experiments are listed with compilations of facts and observations, methods of measurements, concentrations (seasonal, annual, maximum, monthly, or daily average), coexisting elements (such as nitrogen dioxide, suspended particulates settling particles, sulfides, ammonia, hydrogen sulfide, and chlorine), descriptions of effects on health, and the names of researchers. Environmental standards should be set for each specific area in order to control and prevent bad effects on health and disturbances of normal living and to provide the standard for sound judgment of what is to be done towards emission control.

L. LEGAL AND ADMINISTRATIVE

00054

A STUDY OF AIR POLLUTION IN THE INTERSTATE REGION OF LEWISTON, IDAHO, AND CLARKSTON, WASHINGTON. Public Health Service, Cincinnati, Ohio, Div of Air Pollution.(999-AP-8.) Dec. 1964. 166p.

As a result of an increasing number of complaints from citizens about reduced visibility, damage to house paint, tarnishing of silver, undesirable odors, and suspected effects of air pollution on health, Idaho and Washington and Lewiston and Clarkston officials requested assistance from the U.S. Public Health Service. Subsequently, the Public Health Service, the two states, and the two cities agreed to undertake a cooperative study; the two cities participated in the study. The purpose of the study was to determine the nature and extent of air pollution in the two-city area and to assemble information to be used as a basis for technical and official action needed to conserve air quality in the area. Because of its unique valley location, the two-city area is susceptible to meteorological conditions conducive to pollutant accumulation. Either city can contaminate the other, and this creates a multi-jurisdictional problem that requires joint and cooperative action to control air pollution. As a first step to solve the problem, an Air Resources Management Council consisting of county, city, and state officials is to be organized. This council will be responsible for planning surveys and studies to determine air quality guides and legislation and administration necessary to control air pollution in this multi-jurisdictional area. The Public Health Service in its advisory capacity will provide technical assistance. (Author)

00549

D.M. Keagy

THE CLEAN AIR ACT AND ITS EFFECTS. Preprint. (Presented at the Second Annual Meeting, Pacific Northwest International Section, Air pollution Control Association, Portland, Oreg., Nov. 5-6, 1964.)

Activities and programs which are evolving under the influence of the Clean Air Act 1963 are reviewed. Although responsibility for the control of air pollution rests primarily with State and local governments, the Federal Government through the Clean Air Act is better equipped to aid State and local control programs more effectively and to stimulate them to the increased level of activity considered necessary.

00871

J.D. Williams W.S. Smith

AN AIR POLLUTION INCIDENT IN TERRE HAUTE, INDIANA. THE STUDY PLAN AND STUDY. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. (Presented at the Third Conference on Air Pollution Control, Purdue Univ., Lafayette, Ind., Oct. 27-28, 1964.) 12 pp. CFSTI: PB 167 781

The mayor of Terre Haute was first to recognize and examine the air pollution incident in that city. His study began on May 9, 1964, after he had received numerous reports of strong and objectionable odors, of illness and of the darkening of painted surfaces. Since the situation was beyond his available resources, he requested assistance from the Indiana Board of Health and the U.S. Public Health Service. A joint study plan for the area was set up by the PHS and State engineers. Of about 50 samples taken near the 12 possible sources, hydrogen sulfide concentrations greater than 100 pphm were detected at one source. Although medical evaluation did not reveal a disaster situation, it did reveal that the air pollution problem was greater than nuisance value. The report submitted to the city recommended appointment of a committee with specific responsibility for this air pollution problem. Such an appointment would improve communications within the community, and the working relationships between the mayor, the State and industry. A committee has been formed since and it is implementing the recommendations of the report.

00973

A COMPILATION OF SELECTED AIR POLLUTION EMISSION CONTROL REGULATIONS AND ORDINANCES. (REVISED EDITION.) Public Health Service, Washington, D.C., National Center for Air Pollution Control 143p., 1967.

The regulations and ordinances have been arranged in sections which include Smoke Emissions and Equivalent Opacity Regulations, Regulations Pertaining to Particulate Emissions from Fuel Burning Plants, Regulations Pertaining to Particulate Emissions from Refuse-Burning Equipment, Regulations Pertaining to Particulate Emissions from Manufacturing Processes, Regulations Pertaining to Sulfur Compound Emission Control, Regulations Pertaining to Hydrocarbon Emission Control, Regulations Pertaining to Fluoride Emission Control, Regulations Pertaining to Motor Vehicle Emission Control, Regulations Pertaining to Odor Emission Control, and Zoning Ordinances. The regulations and ordinances represent the different methods of controlling emissions by law and varying degrees of control. Some definitions were picked selectively to provide very good definitions while others were picked because of their wide use by many states and communities.

01528

K. Guthmann

(NEW KNOWLEDGE AND EXPERIENCE IN THE PURIFICATION OF AIR IN FOUNDRIES.) Neue Erkenntnisse und Erfahrungen bei der Reinhaltung der Luft in Huttenwerken. Radex Rundschau (Austria), No: 3: 139-162, June 1966.

German laws, passed by the Federal Government, requiring maintenance of clean air, are discussed. Maximum allowable emission values for dusts, gases, and smokes are given. Programs established for research on the measurement of dust and SO2 and warning devices for smog are described. Other research described is being conducted on the removal of brown smoke in basic steelworks and oxygen-blowing steelworks, recovery of converter gas, possibilities for utilizing accumulated dust, removal of fluorine from exhaust gases and removal of odor from exhaust gases.

01604

R.A. Venezia

THE INTERSTATE AIR POLLUTION STUDY: ST. LOUIS - EAST ST. LOUIS METROPOLITAN AREA. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. (Presented at Missouri Public Health Association Convention, Kansas City, May 11, 1965.) 1965. 22 pp.

The Interstate Air Pollution Study of the St. Louis - East St. Louis metropolitan area is described. The study was in keeping with the air resource management concept. Dustfall, suspended particulates, soiling index, sulfur dioxide, oxidants, odors, carbon monoxide, hydrocarbons, nitrogen oxide, nitrogen dioxide, sulfur dioxide, ozone, and visibility were measured. The effects indicated by steel corrosion, nylon and cotton deterioration, asthma, opinion surveys, and complaints were examined. An emission inventory, meteorology, fluorescent tracer diffusion, diffusion models, economic losses, legal aspects, and public relations were studied during the study.

02294

LAW NO. 61-842 OF 2 AUGUST 1961 (ON THE STRUGGLE AGAINST ATMOSPHERIC POLLUTIONS AND ODORS, AMENDING THE LAW OF 19 DECEMBER 1917). Journal Officiel (Translated as JPRS R- 5881-D.) Aug. 3, 1963. 7195 pp.

Newly enacted legislation on air pollution and odors from industrial, non-industrial, agriculatural and other combustion sources, as well as from radioactibe substances and transportation, are the content of this bill. A fine may be inflicted in the event of failure to carry out the work or modifications, within the period prescribed. Under Title II, the legislation dating from 1917 and 1932 is being amended.

02295

PUBLIC HEALTH AND SANITATION (ATMOSPHERIC ODORS AND POLLUTION, DECREE NO. 63-963 OF 17 SEPTEMBER 1963.) Journal Officiel pp. 8539, Sept. 21, 1963. (Translated as JPRS R-5880-D.)

Legislation of September 17, 1963, concerning control of emission of odors and air pollutants from all combustion sources. Noneompliance to be penalized. Special attention is to be given to smokeless zones and established emission standards are to be strictly enforced.

02840

G. B. Welsh and T. E. Kreichelt

CLEAN AIR FOR CHATTANOOGA. Public Health Service, Atlanta, Ga., (Region IV) and Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. July 1964, 77 pp.

The results of limited investigations, based on air quality data obtained during a 30-day sampling period, other available air quality data, evaluation of existing information related to the air pollution problem and a review of the present air pollution control program are presented. Of primary concern in Chattanooga are improper combustion of coal and fuel oil, particulate materials, odors, and fly ash. The sources are industrial, domestic, solid waste and open burning, and motor vehicles. Local meteorological and topographical factors contribute to the accumulation of air pollution in Chattanooga. Low-level inversions occur frequently (about 35 percent of the total hours per year). Although Chattanooga has had a smoke abatement program since 1935 and some progress has been made, there is an apparent need for a more comprehensive air pollution control program.

03198

J. W. Gardner.

AUTOMOTIVE AIR POLLUTION (FIFTH REPORT OF THE SECRETARY OF HEALTH, EDUCATION, AND WELFARE TO THE U.S. CONGRESS IN COMPLIANCE WITH PUBLIC LAW 88-206 AS AMENDED BY PUBLIC LAW 89-272). 90th Congress (1st Session) (Document No. 8) Dec. 1966. 14 PP. GPO 74-5880

The procedure is described whereby the manufacturer may apply for a certificate of conformity and it describes the activities of the certification laboratory established by the Department to verify the manufacturer's test data. The status of legislation at the State level to provide for continued compliance following Federal certification is also covered. The effectiveness of the Federal control program, as it may be anticipated from early experiences under California's similar program, is discussed in a section on surveillance testing. The Federal standards, which were established March 31, 1966, are subject to revision as new dimensions of the problem are defined and as limitations become apparent in the implementation of existing standards. Current standards of emissions control apply to two contaminants, hydrocarbons and carbon monoxide, and to two possible emission sources, crankcase and exhaust systems. It is probable that nitrogen oxide, lead, sulfur dioxide, odor, and particulate components of motor vehicle exhaust will become the subject of future standards; the fuel system and evaporation losses associated with it is the subject of study for early inclusion among systems requiring control. Research studies upon which revised standards and procedures will be based are reviewed. The policy which will prevail in the establishment of new emission standards on a national level is one which will recognize the needs of the most susceptible members of the population at risk and the quality of the air where the risk is highest. Sections of this report deal with the air quality as it refelcts the extent of the automotive air pollution problem in many cities across the United States and its potential influence on the health and well-being of their citizens. (Author summary modified)

03540

J. J. Sableski

THE FEDERAL AIR POLLUTION CONTROL PROGRAM AS IT RELATES TO THE KRAFT PULPING INDUSTRY. Tappi, 50(8):35A-39A, Aug 1968, 24 refs. (Presented at the 52nd Annual Meeting, Technical Association of Pulp and Paper Industry, New York City, Feb. 1967.)

The Federal air pollution control program as it relates to the kraft pulping industry, with particular emphasis on the odorous character of the industry's atmospheric emissions, is described in terms of four individual Federal activities, research, grants-in-aid, technical assistance, and abatement actions. (Author abstract)

04841

Springer, K. J. and R. C. Stahman

AN INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE (A PROGRESS REPORT). Southwest Research Inst., San Antonio, Tex., and Public Health Service, Cincinnati, Ohio, Division of Air Pollution. 1966. 23pp. (Rept. No. FL-66-46.) (Presented at the Fuels and Lubricants Meeting, National Petroleum Refiners Association, Philadelphia, Pa., Sept. 15-16, 1966.)

The objective of the Southwest Research Institute program is to provide long term assistance to the Public Health Service in the development of engineering data regarding diesel emissions. The current project is limited to investigation of two widely used diesel engine-vehicle combinations. For purposes of procedural development, the 2 cycle GM-6-V-71 powered municipal bus and the 4 cycle Cummins NH 220 powered tandem axle inter-city truck tractor are being used. In addition to base line smoke and odor data, determination of vehicle variability involving ten similar buses and ten similar trucks will be made. Limited investigation and evaluation of fumigation and exhaust dilution techniques are also included in the scope of the current programs. To provide realistic guidelines, field studies have been conducted to determine operating conditions that produce significant levels of odor and smoke. At the same time trace gas surveys were conducted to determine the natural dilution which occurs to diesel powered vehicle exhaust. The experience and data resulting from these field studies will then be translated to the laboratory for development of chassis dynamometer road load and inertia simulation procedures. In addition, the odor facility will be utilized and measurement procedures, using the dynamic dilution facility and a ten person odor panel, will be developed. To assure realistic dat, buses and trucks from normal service fleet are utilized. The GM Truck and Coach Model 4519 buses are provided from the San Antonio Transit System and truck tractor units are being supplied by the Ryder Truck Leasing Company. The work to date has been expended on the special preparations required to develop test facilities and procedures and determination of base line data.

04888

K. J. Springer

INVESTIGATION OF DIESEL POWERED VEHICLE ODOR AND SMOKE (MONTHLY PROGRESS REPT. NO. 2, FEB. UK - MAR. 15, 1967). Southwest Research Inst., San Antonio, Tex., Vehicle Emissions Research Lab. Mar. 26, 1967. 16 pp.

Progress is reported on: catalytic muffler evaluation; engine derating; exhaust dilution and oxidation; Jacobs engine brake; fleet test of smoke suppressant; odor correlation chemistry; statistical analysis; and humidity control.

04942

F. B. Kaylor

AIR POLLUTION ABATEMENT PROGRAM OF A CHEMICAL PROCESSING INDUSTRY J. Air Pollution Control Assoc. 15, (2) 65-7, Feb. 1965.

Solvay Process, a Division of Allied Chemical Corporation, utilizes Onondaga County's only two mineral resources, salt and limestone, to manufacture soda ash as well as caustic soda, chlorine, calcium chloride and chlorinated organics. The following areas involved most of the major pollution complaints: particulate matter from the boiler house, dust and fumes from the lime kilns, smoke and soot from the ammonia-caustic soda concentration operation, smoke and soot from soda ash calcining operation, and occasional situations where odors and reactions of sulfur dioxide were noticeable. The abatement program and its costs are described.

05129

A. Turk

SELECTION AND TRAINING OF JUDGES FOR SENSORY EVALUATION OF THE INTENSITY AND CHARACTER OF DIESEL EXHAUST ODORS. City Coll., New York. (PHS Publ. No. 999-AP-32.) 1967. 50 pp.

Exhaust gases emitted by diesel engines are characterized by offensive odors. These odors must be rated numerically by human judges with the ultimate objectives of (1) correlating such ratings with the chemical composition of diesel exhaust and (2) establishing Federal standards for control of diesel exhaust odors. Judges are selected on the basis of (1) their ability to distinguish among odors of different intensities and qualities, and (2) their behavior in subjective testing environments. The chosen judges are then trained to improve their performance in odor discrimination, to become familiar with diesel exhaust odor, and to rate the odor in terms of intensity and quality standards that are provided to them for reference. These standards comprise a scale of overall odor intensity, and four odor quality scales that correspond to the descriptions 'burnt/smoky,' 'oily,' 'pungent/acid,' and 'aldehydic/aromatic.' Appendices describe (A) the theoretical basis for air purification requirements in test chambers for odor studies, (B) the composition and makeup of the diesel odor standards, and (C) the mathematical derivations of the statistical procedures.

06732

H. W. Gehm

STATEMENT BY H.W. GEHM FOR SENATE SUBCOMMITTEE ON AIR AND WATER POLLUTION. 90th Congress 'Air Pollution--1967, Part IV (Air Quality Act)' Senate Committee on Public Works, Washington, D.C., Subcommittee on Air and Water Pollution, May 15-18, 1967.) pp. 2361-7, 2370-82.

Dr. Gehm is technical director of the National Council for Stream Improvement of the pulp and paperboard industries. In his statement, Dr. Gehm reviews the industry's understanding of its atmospheric emission control problems, the development of its control technology, the current state of the art and its limitations, and the industry's research and development efforts to remove these limitations. Discussed in an attachment to Dr. Gehm's statement are black liquor oxidation, absorption and oxi- dation of sulfur compounds and particulate emission control.00

07235

R. Langmann

CLEAN AIR MAINTENANCE-A TASK FOR THE OFFICE OF PUBLIC HEALTH. Die Reinhaltung der Luft als Aufgabe des Gesundheitsamtes. Oeffentl. Gesundheitswesen (Stuttgart) 29 (3), 126-34 (Mar. 1967). Ger.

Government regulations request that the office of public health pays attention to the maintenance of clean air. More specifically, it must screen projected industrial enterprises as to the degree of their expected air polluting emissions and the eventual impact on the health of the employees and the neighboring inhabitants. In cases where the office of public health through its investigations finds evidence of health hazards, it must recommend various ways of avoiding or eliminating the pollution of air. A large number of pollutants are discussed, such as dust, toxic gas- es, and obnoxious vapors and odors. Their sources and methods for their elimination are discussed in detail and represented by examples. Particular emphasis is placed on proper city planning, zoning, and a more stringent application of regulations concerning the construction of new plants, especially their chimneys. Further investigations into possibilities of remote heating and of substituting gas and electricity for coal are recommended. Finally, the importance of educating the public on the consequences of air pollution is stressed.

07781

Muskegon County Health Board, Mich.

MUSKEGON COUNTY AIR POLLUTION CONTROL RULES & REGULATIONS. 20p., April 11, 1967.

The purpose of these regulations is to reduce and prevent air pollution caused by soot, cinders, fly ash, dust, noxious acids, fumes, gases and odors. Included are: emission limitations, penalties for violations and a tabulated particulate matter emission schedule.

09215

Frick, R.

AIR POLLUTION BY MOTOR VEHICLE EXHAUST GASES. (POLICE REGULA- TIONS AND THEIR ENFORCEMENT.) ((Die Verunreinigung der Atmos- phare durch Abgase der Motorfahrzeuge. (Polizeiliche Vorsch- riften und ihre Durchsetzung.))) Text in German. Z. Prae- ventivmed. 11(2):252-256, March-April 1966.

A discussion is presented of regulations which are in force to curb automotive air pollution in Switzerland. They include: trucks with trailers must be capable of negotiating 15 percent hills with full load; engine performance mhst amount to 10 hp. per ton of total weight of the truck and 6 hp. per ton of total weight of truck with trailer. Vehicles producing smoke or odor do not pass inspection. Regulations concerning the design and performance of the exhaust system are also discussed.

09604

Maryland State Dept. of Health, Baltimore

43P05 REGULATIONS GOVERNING THE CONTROL OF AIR POLLUTION IN AREA IV. Preprint, 10p., March 29, 1968.

A regulation governing area IV in the State of Maryland specifies the control and prohibition of: visible emissions; particulate matter from fuel burning equipment, incinerators, other installations, material handling; gas, vapor and odor emissions; and open burning. No control equipment that may produce emissions can be operated such that a nuisance is created. Area IV is comprised of Montgomery and Prince George Counties.

09677

Public Health Service, Washington, D. C., National Center for Air Pollution Control

A COMPILATION OF SELECTED AIR POLLUTION EMISSION CONTROL REGULATIONS AND ORDINANCES. (REVISED EDITION.) 142p., 1968.

This compilation contains selected sections of many emission con- trol regulations and ordinaces. It has been prepared to provide state and local air pollution control agencies, industries, and other interested people with selected examples of the many types of regulations and ordinances in use today. All sections of regula- tions and ordinances included have been copied directly from the original text of individual state and local laws. The regula- tions and ordinances have been arranged in such a manner that each section of this report is a compialtion of laws pertaining to a specific type of pollutant or pollutant source. These sections include Smoke Emissions and Equivalent Opacity Regulations, Particulate Emissions from Fuel Burning Plants, Particulate Emissions from Refuse-burning equipment, Particulate Emissions from Manufacturing Processes, Particulate Emissions from Asphalt Batching Plants, Sulfur Compound Emissions, Organic Solvent Emissions, Hydrocarbon Emissions, Fluoride Emissions, Motor Vehicle Emissions, Odor Emissions, and Zoning Ordinances. The regulations and ordinances compiled were selected to represent the different methods of controlling emissions by law and to represent varying degrees of control.

10484

Huey, Norman A.

AMBIENT ODOR EVALUATION. Preprint, Public Health Service, Cincinnati, Ohio, National Center for Air Pollution Control, 10p., 1968. 2 refs. (Presented at the 61st Annual Meeting of the Air Pollution Control Association, St. Paul, Minn., June 23-27, 1968. Paper 68-15.)

Data are presented which may serve as a basis for the formulation of ordinances controlling odor pollution. The problem of odor measurement and evaluation are considered for the purpose of determining what measurement methodology should be specified in control ordinances. Any viable ordinance pertaining to odor control must be based on an understanding of how odors occur, their frequency, their duration, and their strength. These aspects of the problem are discussed, as well as the general problem of evaluating the objectionability of odors. Suggestions are made as to measurement requirements and a methodology for satisfying these requirements is presented. The function and potential usefulness of the 'Scentometer' are described. (Author's abstract, modified)

10567

AIR POLLUTION CONTROL. Philadelphia Med., 64(14):658, July 20, 1968.

The Air Pollution Board of Philadelphia has adopted revised incinerator regulations which will prohibit the issuance of permits for the construction of new incinerators used in the disposal of ordinary apartment-commercial-industrial refuse after January 1, 1969. Within one year of that date, all incinerators are to be equipped with devices to meet stringent emission standards; all current incinerator owners will be required to certify by February 1, 1969, that their units will be shut down, upgraded, or replaced. The new regulations call for installation of equipment which will reduce particulates in flue gas to 0.2 or 0.6 lb./100 lb. gas, depending on gas charging rate; for smoke emission density not exceeding Ringelmann No. 1 or its equivalent for more than 30 sec. in any one hour or a total of 3 min. in any day; and for control of odors from incinerators such that odors shall not be detectable in any area for human use or occupancy. These regulations must be approved by the Philadelphia Board of Health, and by the City's Law and Records Departments, after which a final adoptive date will be established.

12376

Martland, L.

EMISSIONS FROM GASOLINE MOTOR VEHICLES. Inst. of Mechanical Engineers, London (England), Automobile Div., Symp. Motor Vehicle Air Pollution Control, London, 1968, 4p. (Nov. 25-26, Paper l.)

The British Technical Council (B.T.C.) was started in 1963 and is composed of single representatives from each of the major motor and petroleum companies to provide cooperative consultation and action on technical problems. In the same year the B.T.C. and similar bodies from other West European countries formed the Co-ordinating European Council (C.E.C.). The activities of these organizations in the air pollution matters are outlined, and California and U. S. Federal regulations on pollution are reviewed. The Bureau Permanent International des Constructeurs d'Automobiles, composed of manufacturers' associations from all countries producing motor vehicles, made a strong recommendation to the Economic Commission for Europe in 1966 that air pollution regulations in terms of procedures and levels should be standardized for all countries of Europe. The recommendation was accepted, and subsequently the B.T.C. Fuels Committee contributed significantly to the final European recommendations for control of exhaust emission from gasoline-engine cars and derivatives, to be applied as a type test acceptance. In new U. S. regulations, levels of emissions are controlled on a basis of mass flow instead of proportion of total exhaust gas volume as previously; this aligns with the European method. Although diesel emissions do not constitute a public health hazard the opacity of diesel smoke can be a driving hazard. Odor and deposition from the smoke are also problem areas. Thus the various national and international organizations have more recently initiated programs to design and implement control of diesel emissions as well.

12511

Stumph, Terry L. and Robert L. Duprey

TRENDS IN AIR POLLUTION CONTROL REGULATIONS. Preprint, Air Pollution Control Association, New York City, 40p., 1969. 19 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 62nd, New York, June 22-26, 1969, Paper 69-175.)

Recent trends in air pollution control regulations adopted by state and local agencies were analyzed. Emphasis was on the concepts of control regulations rather than on specific emission limits. Trends in control regulations are towards preventing air pollution through required application of known control techniques. Outmoded concentration emission standards are rapidly being replaced by those that limit total mass-emission rates. Allowable emission rates usually vary according to the size of the source. Control of all visible emissions is being accepted as necessary to any control program. Particulate matter from fuel-burning equipment is being controlled to a high degree; emission standards for sulfur oxides from fuel combustion are anticipated in the near future. Incinerator emissions standards are relatively undeveloped, due to lack of knowledge about the performance of high-efficiency dust collectors on these sources. Control of many types of process industries presents a challenge in the design of equitable emission standards. The familiar process-weight-rate regulation is rapidly becoming the standard for limiting particulate matter from this source category. The potential- emissions-rate concept shows promise for certain source types and pollutants. Odor regulations have mainly involved ambient air measurements using the human sense of smell. (Author abstract modified)

14028

FILTRATION OF WASTE AIR FROM DRY CLEANING MACHINES. (Filterung der Abluft aus Reinigungsmachinen). Text in German. Wasser Luft Betrieb, 13(4):127-128, April 1969.

The fifth regulation of the Law for the Prevention of Air Pollution in North Rhine-Westphalia of 1967 is now in effect. It concerns all machines for cleaning and drying textiles, leather goods, or furs if they operate with chlorinated hydrocarbons in the form of trichloroethylene or perchloroethylene. The regulations pertain to all sizes of machines so that tumble driers and coin-operated cleaners are also affected. In a departure from other regulations, a specific method for cleaning of the waste air is required, namely, filtration with activated coal. The concentration limit cannot exceed 200 mg of solvent per cu m waste air. Commercially available activated coal is capable of storing 25 to 35% more solvent than must be regenerated. For this reason, installation of two filters is recommended. The efficiency of a charcoal filter is rather high, so lower concentrations than the prescribed limit concentration are obtained. Since the odor threshold of trichloroethylene fluctuates between 260 and 520 mg/cu m and that of perchloroethylene is 360 mg/cu m, the effectiveness of the filter can be roughly evaluated by the presence or absence of odor at the filter outlet. According to the regulations, official inspections will be made once a year without charge. For this purpose, the Draeger trace gas-measuring unit will be used. The solvent retained by the activated coal can be recovered and returned to the process. Investment costs should be amortized within two years.

14616

Commission on Earth, Water, and Air, Rotterdam

REPORT ON THE YEAR 1967. (Verslag over het jaar 1967). Text in Dutch. 128p.

The Commission on Earth, Water and Air Pollution, Rotterdam, is composed of engineers and scientists from various municipal commissions and public service departments. It works closely with other municipal groups and industrial associations to regulate pollution in the area around the mouth of the Rhine, collaborating on guidelines for municipal ordinances and emission standards. The commission operates an extensive measurement network and maintains laboratory facilities for the chemical analysis of pollutants. One of its purposes is to compile a report pf all public and private activities relating to combating the pollution of earth, water, and air. This report for 1967 surveys the reduction in pollution effected by measures undertaken by municipal power operations, municipal plants, and private industry in the Rotterdam area; control methods still under study; sources of water pollution; complaints about the dispersion of unpleasant odors, smoke, soot, and fog; the possible relation between air pollution and bronchitis in municipal employees and school children; results of atmospheric measurements; and the preparations for a national environmental hygiene literature pool. In 1967, pollution caused by smoke, sulfur dioxide, and polycyclic hydrocarbons continued to decrease, indicating that conditions imposed by authorities and efforts made by industries were largely successful. Measurement data and meter readings are tabulated. Maps of the measurement network are included.

14798

Liedmeier, G. P.

PREVENTION OF ATMOSPHERIC POLLUTION IN PETROLEUM REFINERIES. (La prevention de la pollution atmospherique dans les raffineries de petrole). Text in French. Pollut. Atmos. (Paris), 11(Special):3-8, Feb. 1969.

A review of atmospheric pollution and problems in controlling it in the refineries of Europe is presented. The author discusses the founding of CONCAWE (Conservation of Clean Air and Water-- Western Europe), which is a group of oil companies and societies representing 80% of the refining capacity in Western Europe. Its functions are to process information pertaining to pollution by refineries and the joint study of pollution problems. It now has working groups in the following areas: study of the height of chimneys and atmospheric dispersion; liquid effluents; petroleum pipelines; subterranean migration of petroleum; and noise abatement. The sources and effects of refinery pollution, particularly by sulfur oxides, hydrocarbons, and malodorous gases are reviewed. Particulate matter and nitrogen oxides are considered of secondary importance. A brief review of methods for combatting pollution is also included.

14932

AGREEMENT BETWEEN FUJI CITY AND DAISHOWA PAPER MANUFACTURING CO. IN RELATION TO THE PREVENTION OF EXISTING PUBLIC NUISANCE. (Fujishi oyobi Daishowa seishi kabushikigaisha no kisonkogai no boshi ni kansuru kyoteisho). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 5(6):475-478, June 1969.

An agreement between the city of Fuji and the Daishowa Paper Mfg. Co. with respect to environment sanitation and protection of the local residents from industrial pollution is presented. The eight items of the agreement were: (I) The company is to install air pollution control facilities before the prescribed date. (II) The company will follow the occasional recommendations made by Fuji City when the need arises. (III) The company should obtain approval from the city for alteration of the conditions specified in any articles in the agreement. (IV) Fuji City is allowed to request data on the air pollution control installations from the company and is permitted to inspect the inside of the plant. (V) If any detrimental effects are felt by the local residents in spite of the existing agreement, the company should promptly take countermeasures. (VI) The company is encouraged to cooperate in beautifying the area surrounding the plant. (VII) The company is required to take prompt action if any damage to community buildings occurs. (VIII) Both Fuji City and the company are responsible for anything not mentioned above. Existing pollution control plans include decreasing SO2 emissions; alkaline mist diffusion control; noise and odor control; and waste water pollution control. The city is responsible for keeping the emission standard constant, and the company will keep alkaline emissions to 0.075 g/N cu m.

15554

Cross, Frank L., Jr. and Roger W. Ross

CURRENT STATUS OF AIR POLLUTION CONTROL REGULATIONS FOR ASPHALT PLANTS AND SIMILAR DRYING OPERATIONS. Preprint, Public Health Service, Durham, N. C., National Air Pollution Control Administration, 12p., Sept. 1969. 5 refs.

Current regulations for controlling emissions from asphalt plants are reported for 38 states and 6 local agencies. Nine states, and one local control agency, have specific regulations for asphalt plants. These regulations include particulate matter and smoke, but not odors or other pollutants. Four of the states base their regulations on the amount of pollution emitted per 1000 pounds of flue gas discharged; two others base theirs on a process weight table, and require a specific collection efficiency for control equipment; the remaining use a concentration standard and/or a buffer zone. The remaining 29 states, and five local control agencies, have regulations applicable to all industrial processes and apply them to asphalt plants. Most of these states use p4cess weight tables for control of particulate matter. Many also require that visible emissions not exceed Number 2 on the Ringlemann Scale or equivalent opacity. Nine states employ a standard for odor control. Although most of the odor regulations are general in nature, one state stipulates the use of a scentometer for odor measurement.

15688

CONTROL OF AIR POLLUTION. Intern. Digest Health Legislation, 20(3):418-419, 1969.

The principal provisions of a regulation under an air pollution control act for Ontario are presented. Terms defined include fuel burning equipment, odor, and smoke. Sources of air pollution exempt from governmental regulation and fuel burning equipment for comfort heating, on-site construction equipment for maintenance and construction of public roads, domestic incinerators, equipment for food preparation in restaurants, bakeries, dry-cleaners, personal residential equipment, and equipment for seeding, harvesting, fertilizing, or pest and weed control on agricultural lands. The regulation also states that equipment may not be operated which do not comply with minimum air quality standards or emit disagreeable odors. A smoke density chart is provided for which determines the allowable smoke density for a given period of time or for specific operations. The regulation prohibits the emission of pollutants from incinerators and waste disposal units and the operation of municipal incinerators other than at the prescribed hours. Fuel burning equipment for the burning of solid fuel in suspension may not be operates without the use of dust separating equipment. Maximum allowable concentrations for use in assessing air quality are also prescribed.

15691

BASIC PLAN FOR PUBLIC NUISANCE CONTROL IN IBARAGI PREFECTURE. (Ibaragiken kogai boshi kihon keikaku). Text in Japanese. (Ind. Public Nuisance), 5(7):389-398, 1969.

A fundamental plan for the control of public nuisances is presented which conforms to the Public Nuisance Control Regulation in Ibaragi prefecture. A basic attitude towards public nuisance control and policies which promote the extermination of major sources and factors of public nuisance are given. The purpose of this plan is to preserve the living environment by bringing under control unpleasant odors, sewage or waste water, noise, vibration, stack smoke, dust, and gas. Land use control, enforcement of water range control, and adjustment and preservation of the living environment constitute actual measures which can be taken. The development and practice of control techniques are being researched. A survey is recommended of the existing pollution severity with respect to classification and localization. A collective control system consisting of all these divisional activities is to be established to make a final decision. Collection of all the available ideas or countermeasures on the national scale and transmission of these to local bodies is strongly encouraged.

16330

Stumph, Terry L. and Robert L. Duprey

TRENDS IN AIR POLLUTION CONTROL REGULATIONS. Environ. Control Management, 139(2):45-46, Feb. 1970. 2 refs. (Presented at the 1969 Annual Meeting of the Air Pollution Control Association.)

Existing odor control regulations consist of a variety of partially successful measures. These include nuisance type restrictions based on ambient air detection of odors, process restrictions for certain known odor-producing sources, and control equipment requirements for specific source operations. Most odor regulations are directed at measurement of odors in the ambient air. This approach is justified because human response to ambient odor must be the ultimate criterion of acceptable odorous emissions. St. Louis adopted a regulation that allows a panel of observers to evaluate odor intensity of ambient air samples when such samples are diluted with specified quantities of odor-free air. A similar procedure was proposed by Huey but did not offer a method for abating such odors at the source. Odor control regulations in the form of process restrictions and control equipment specifications were applied to certain known odor- producing operations. Los Angeles, St. Louis, and many other agencies require that effluents from animal matter reduction be incinerated at a temperature of 1200 F for at least 0.3 seconds. Los Angeles County Air Pollution Control District developed a quantitative odor-measurement that can be applied at the source. Odor concentration is expressed in odor units per standard cubic foot of flue gas. Possible developments in control regulations include required elimination of all visible emissions, emission standards for sulfur oxides from fuel combustion, process-weight-rate and potential-emission-rate regulations for specific industry types for particulate and gaseous pollutants, mass-emission-rate standards that require application of modern flyash collectors to incinerators, and emission standards that limit the mass rate of emission of odors measurable by source sampling.

17258

PUBLIC NUISANCE CONTROL PROGRAM. (Kogai boshi keikaku no sakutei ni tsuite). Text in Japanese. Taiki Osen Nyusu (Air Pollution News), no. 53:2-12, July 1969.

A public nuisance control program for three regions in Japan was presented. Details of the control program were explained. Each of the three regions is characterized by promising development in petroleum refining the petro-chemical industry, production of thermal power, and the iron and steel industry. Considering this background, proper steps were strongly encouraged in a composite and extensive scheme. The goals were divided into four categories: the air pollution category included sulfur oxides, suspended particulates and odors, the water pollution category included a water quality standard for drinking water, river water for fish, river water for other use, and water concerned with the living environment; the noise blocking category dealt with a phone standard in the daytime, morning, evening, and night; and a ground subsidence category. Procedures required for enforcement were concerned with concrete control means for pollutant sources and other means concerning ground use along with living environment consolidation. Precise and valid data obtained by research activities can contribute to the performance of an observation and supervision system. Mutual cooperation must be attained between a party in practice and its counterpart, the regional residents and local autonomy to pursue the program. Adjustment of the program with existing control programs was stated. A marked difference among the three designated regions in the basic purpose and framework of the program was not demonstrated.

19059

Bistowish, Joseph M.

NASHVILLE'S AIR POLLUTION PROBLEM: PAST, PRESENT AND FUTURE. Vanderbilt Univ., Nashville, Tenn., School of Engineering, Tennessee Stream Pollution Control Board, Tennessee Dept. of Public Health, Proc. Conf. Environ. Water Resources Eng., 8th Ann., Nashville, Tenn., 1969, p. 171-177. (June 5-6).

The provisions and implementation of an air pollution control ordinance prepared by the Nashville Health Department are discussed. The ordinance regulates visible emissions from all fuel or refuse burning equipment. It is unlawful to burn any solid or liquid fuel containing more than 2% sulfur by weight. New incinerators must be multiple chamber incinerators having capacities of 100 lbs/hr with auxiliary heat sources to prevent air pollution. No incinerator may emit fly ash or other particulates in excess of 0.2 grain/cu ft. Automobiles and trucks may not emit visible air contaminants in excess of Ringelmann No. 1. The ordinance also regulates odors, dusts, and emissions from laundries, dry cleaning plants, and similar operations. The air pollution control division is divided into three sections: engineering, enforcement, and laboratory. The progress of implementation of the ordinance is also discussed.

22343

Hoeffken, Fritz

EXCERPTS FROM THE WELCOMING ADDRESS OF THE DIRECTOR, INSTITUTE OF WATER, SOIL, AND AIR SANITATION, FEDERAL DEPARTMENT OF SANITATION. **(Aus der bergruessungsansprache des leiters des institutes fuer Wasser-, Boden- und Lufthygiene im Bundesgesundheitsamt). Text in German. Schriftenreihe Ver. Wasser Boden Lufthyg. (Berlin), no. 30:5-7, 1970.**

The history of the Institute of Water, Soil, and Air Sanitation in West Germany is traced. As early as the 1920s it had initiated interdisciplinary cooperation in the study of air pollution, which brought together the combined gifts of chemists, medical scholars, biologists, a meteorologically trained physicist, and the German weather bureau. At present there are 3 important study groups presently being developed which are concerned with the following problems: effect of pollutants on humans and animals; diffusion of pollutants in the atmosphere (relating emission to immission, taking account of orographic and meteorological conditions); the origin of pollutants and their prevention. Among the major problems still confronting those engaged in air pollution control are the reduction of sulfur dioxide emissions, the elimination of unpleasant odors in the vicinity of chemical plants, fish meal factories, and plastic industries; and the problems created by automotive transportation.

23754

Walsh, Robert T.

THE BISHOP CASE - AN INTERSTATE ODOR PROBLEM. Preprint, National Air Pollution Control Administration, Durham, N. C., Div. of Abatement, 11p., 1970. 2 refs. (Presented at Rutgers University, New Brunswick, N. J., May 13, 1970.)

The rendering plant of the Bishop Processing Co. in 1965 became the focal point of the first interstate abatement conference initiated under the Clean Air Act. The plant, located in Maryland, was causing a severe odor pollution problem in the nearest community, Selbyville, Del. A technical investigation evaluated the odor potential of each process in the plant and the control measures in use or potentially applicable; then the abatement conference was held, with officials from Md., Del., and the Dept. of Health, Education and Welfare unanimously recommending remedial measures. Company failure to carry these out led to the first public hearing conducted under the Clean Air Act, then to a suit in the U. S. District Court in Md. which upheld the abatement provisions of the Act and their application by National Air Pollution Control Administration officials. The same court later ordered the plant shut down as required by the terms of a consent degree signed by the company in a pre-trial action. The company appealed to the Supreme Court, which, in deciding not to review the lower court's cease and desist order, upheld the decision and the Act.

25446

Drowley, W. B.

AIR MANGEMENT IN ONTARIO, CANADA. Preprint, International Union of Air Pollution Prevention Associations, 37p., 1970. (Presented at the International Clean Air Congress, 2nd, Washington, D. C., Dec. 6-11, 1970, Paper AD-11C.)

The history of air pollution control legislation in Ontario is reviewed; a description is provided of control requirements and air quality and meteorological monitoring. Although the first control legislation was contained in The Municipal Act dating back to the turn of the century, another act was passed in 1967 whereby the Province assumed the total control function. Salient features of this Act are cited, while its administration was transferred to the Department of Energy and Resources Management and renamed the Air Management Branch in June 1969. The Branch is organized into the following sections: abatement, approvals, air quality and meteorology, phytotoxicology, automotive, and laboratory. For administrative purposes, the Province has been divided into seven regions and the regions further divided into districts. Smoke control and emission limitations are mentioned, as well as the use of diffusion equations. Vehicle emissions are discussed, including standards and criteria for desirable air quality. The Ontario Air Pollution Index is based on the continuous measurements of sulfur dioxide and suspended particulate matter. Problems concerning odors and water pollution are mentioned. Air quality monitoring is carried out at 31 locations, involving some 340 sampling sites. The phytotoxicology section is responsible for the investigation of complaints of injury to vegetation by air pollution, for the documentation of cases which may result in economic loss, and for conducting surveillance studies. The problem of transboundary air pollution is mentioned, and the staffing and budget of the Air Management branch is discussed.

26511

Wehnert, Klaus

HALLE EXPERIENCES IN PURIFICATION OF AIR AND WATER DESCRIBED. In: Translations on Eastern Europe Scientific Affairs. No. 121, Washington, D. C., Joint Publications Research Service 1970, p. 21-25. (Also: Sozialistische Demokratie (East Berlin), 1970:8, May 15, 1970.) NTIS: JPRS 50855

Due to a combination of chemical processes and the lignite industry, there is a high level of air pollution in the Merseburg-Halle-Bitterfeld industrial area. Dust and large quantities of sulfur dioxide are emitted, while severe odor problems result from the chemicals. In September 1967, district leadership of the Halle organized a task force entitled the 'Purification of Air and Water', followed by an experiment in the use of economic levies. New designs were established for minimum emissions, decreasing the money for dust and waste gas control. Thus, the sources of emissions could be differentiated. Implementation of the economic experiment necessarily brought about more cooperation between the state organs and local enterprises. The workers also were well informed concerning air purification.

26940

West Virginia Air Pollution Control Commission

REGULATION IV--TO PREVENT AND CONTROL THE DISCHARGE OF AIR POLLUTANTS INTO THE OPEN AIR WHICH CAUSES OR CONTRIBUTES TO AN OBJECTIONABLE ODOR OR ODORS. West Virginia Administrative Regulations, Chapt. 16, Article 20, Ser. 4, 5p., 1967.

Upon receipt of a complaint of odor pollution, the Air Pollution Control Commission investigates the complaint and, if warranted, issues a 'Notice of Violation' to the violator. The Commission is authorized to hire or contract for the services of specialists in the area of odor evaluation. Upon receipt of the notice, the violator must present a control plan to the Commission. Following approval of the plan, the person responsible for the discharge shall not be considered in violation so long as the provisions of the plan are observed. Under emergency conditions, the Commission is permitted to issue a variance for a specified period of time when such a variance is properly applied for. Penalties for violation are provided in the Air Pollution Control Law and may only be imposed by the courts. Maximum penalty under the law is $1000/day of violation. Internal combustion engines and operations associated with the production of agricultural products grown on the premises, or livestock, dogs, cats, and poultry are exempt from this regulation.

27184

Yokohama Center for Public Nuisance (Japan)

POLLUTION PREVENTION CONTRACTS I. (Kogai boshi keiyaku dai 1 pen). Text in Japanese. Yokohama Center for Public Nuisance Rept. no. 25:1-119, May 1970.

Since not much authority is given local autonomous bodies, all they can do in preventing pollution is give administrative guidance to the enterprises, without, however, binding force. Yokohama city decided to sign a contract with the enterprises. The important item common in these contracts is that the enterprises shall take sufficient measures in preventing pollution. When pollution does occur, despite these measures, solutions must be made on the responsibility of the enterprise. The city can direct the enterprise on preventing pollution. When no directive is given, th city will take measures on behalf of the enterprise, and the expens shall be borne by the enterprise. Since the start of this system, the citizens' movement has quieted down. Correspondence between th mayor and the enterprises, numbering 15, including power generation oil refinery, gas, chemical and industrial, and the agreements signed between the mayor and the enterprises are included in the pamphlet, as well as the sales contract of the reclaimed land at Yokohama harbor, signed by more than 200 enterprises concerned in order to prevent pollution such as noise, vibration, filthy water, effluent, smoke, dust, gas, and odor. The exchange of correspondence indicates the proposal made by the city and counterproposals, and pledges made by the enterprises. The first contract was with a thermal power generating station, the construction of which started a citizens' campaign against it. Yokohama city, since 1956, has measured dust fall and sulfur dioxide, and dealt with complaints concerning pollution from May 1961, entrusted by the prefectural government. In April 1964, the Pollutions Subsection became independent. When the subsection proposed to change the site of the thermal power station, arguments were stirred up. Since then, the city requested the cooperation of scholars and the meteorological station, and was fully armed with pertinent and scientific data when proposals on contracts with enterprises came to be made and agreed to.

27185

Yokohama Center for Public Nuisance (Japan)

ON FACTORY POLLUTION. (Kojo kogai o kangaeru). Text in Japanese. Yokohama Center for Public Nuisance Rept., p. 1-13, June 1970.

In the Tokyo-Yokohama area, there are nearly 100,000 factories, including heavy industry, such as automobiles, metal products, and iron and steel. In 1968, there were 520 cases of pollution reported: 245 on noise; 92 bad odor; 71 sooty smoke; 47 poisonous gas; 28 vibration; 18 waste liquid; 9 dust; and 10 others. They were handled by the Pollution Center and Public Health Clinic. The National government has authority over power generating stations, city gas manufacturing, and almost all authority over the oil refinery and petro-chemical industry;

local government has only limited authority for other types of factories. Kanagawa prefectur is responsible for planning a pollution prevention program for a special area in the prefecture, and under the Air Pollution Prevention Law, under special circumstances, it is responsible for supervising factories which have smoke emitting facilities, as well as control over high pressure gas. For certain waters, the prefecture is responsible for maintaining water quality under the Water Quality Control Law. The prefecture is responsible for makin big factories take urgent measures on fuel control, but Yokohama city is responsible for watching the situation of air pollution constantly, controlling poison gas spreading on the ground, noise, and boiler and exhaust gas from automobiles. Twenty employees work at the City's Pollution Center. Yokohama city became famous for first signing the agreement with factories which may be sources of pollution, as well as establishing the constant checking system and centralized control system. Citizens were invited to see some of the surveys being conducted. Experience gained enabled the city to forecast pollution, so that the predicted air pollution by sulfur dioxide was close to the actual one, under certain conditions. A few cases of noise and waste liquid from a plating factory are cited. The city, after being consulted by the citizens, acted as a intermediary in the solution of these cases.

27677

Osaka Prefectural Government (Japan)

OSAKA PREFECTURE PUBLIC NUISANCE CONTROL CODE (PROPOSED). (Osakafu kogi boshi joreian). Text in Japanese. 29p., Feb. 1971.

The proposed code for Osaka Prefecture consists of general regulations, measures to control public nuisances, such as environmental standards, public nuisance control plans, and regulations for factories, including regulating smoke and dust, and reporting nuisance-creating facilities. Public nuisances from factories consist of smoke and dust, polluted water, bad odors, noise, and vibrations. There are special provisions concerning extraction of ground water, special construction activities, automobile traffic, use of loud speakers, and monitoring of air pollution. Air pollutants under consideration are sulfur oxides, dusts, cadmium, chlorine, hydrogen fluoride, lead and other substances potentially harmful to human health.

27678

Kanagawa Prefecture (Japan), Public Nuisance Control Promotion Headquarters

REGULATIONS CONCERNING THE PREVENTION AND CONTROL OF PUBLIC NUISANCE. (Kogai boshi jorei kankei reikishu). Text in Japanese. 35p., 1970.

The regulations and amendments which concern the prevention and control of public nuisances in Kanagawa Prefecture are listed. Regulations concerning enforcement are also included. Various machines, manufacturing processes, and production processes that involve public nuisances, such as noise, vibration, water pollution smoke, dust, gas, and odor are tabulated and are categorized according to the applicable sections of the regulation. Various sample forms used to report the nuisance- producing facilities and operations are attached. Environmental standards are presented for diverse pollutants in water according to the water areas of the prefecture, and the Japan Industrial Standard tests applicable to each pollutant are listed. Standards are also given for air pollutants such as sulfur oxides, ammonia, hydrogen cyanides, and nitrogen dioxide, as well as for the allowed stack heights. The levels of noise allowed for different times of day and for different geographical areas are specified.

27679

Kanagawa Prefecture (Japan), Dept. of Planning and nvestigations

REGULATIONS CONCERNING THE PREVENTION AND CONTROL OF PUBLIC NUISANCE. (Kogai boshi jori kankei reikishu). Text in Japanese. 86p., 1968.

The regulations concerning the prevention and control of public nuisance in Kanagawa Prefecture are presented. Enforcement regulations are also included. Various machines, manufacturing processes, and production processes that involve public nuisances such as noise, vibration, water pollution, smoke, dust, gas, and odor are tabulated, and are categorized according to the applicable sections of the regulations. Various sample forms used to report the nuisance-producing facilities and operations are attached. Environmental standards are presented for diverse pollutants in water according to the water areas of the prefecture to each pollutant are listed. Standards are also given for air pollutants such as sulfur oxides, ammonia, hydrogen cyanides, and nitrogen dioxide, as well as for the allowed stack heights. The level of noise allowed for different times of day and for different geographical areas are specified.

28348

Kanagawa Prefecture (Japan), Public Nuisance Prevention Center

ANNUAL REPORT OF KANAGAWA PREFECTURAL PUBLIC NUISANCE PREVENTION CENTER. (Kanagawaken kogai senta nenpo). Text in Japanese. 102p., 1968,

The history of the Kanagawa Prefecture Public Nuisance Prevention Center, its organization, the jurisdiction of detection, administrative aspects and research budgets, are given. The activities of the Center for the year, dealing with complaints, diffusion activities (use of gas absorption equipment, exhaust gas tester), and those on air pollution (survey of air pollution in Tokyo-Yokohama industrial area, coastal area, survey of sulfur dioxide emissions from factories, analysis of fuel oil, survey of odor from factories designated as sources of public hazards, patrolling coastal areas. patrolling factories when air pollution becomes acute, and surveying the effects of air pollution on plants) and on water pollution survey of rivers, factories, seas, water control patrol, survey when pollution becomes acute), and business connected with noise (survey of noise from factories, vibration caused by factories, noise due to traffic, vibration due to traffic, survey on noise from construction work, and street noise) are described. The lecture meetings held under the auspices of the Center are given. The BOD continuous and automatic gauge, developed by the Center, is explained; the device also records pH.

28363

Osaka Prefecture (Japan), Bureau of Hygiene

FULL TEXT OF OSAKA PREFECTURAL POLLUTIONS PREVENTION REGULATIONS AND REGULATIONS ON THE ENFORCEMENT OF OSAKA PREFECTURAL REGULATIONS ON PREVENTION OF POLLUTIONS. (Osakafu kogai boshi jorei, Osakafu kogai boshi jorei seko kisoku). Text in Japanese. 19p., 1970 (?).

Osaka Prefectural Regulations No. 35 on the prevention of pollution were used on October 17, 1969 and became effective April 1, 1970. The full text of the Regulation is given. Chapter topics are as follows: general rules (Articles 1-3); control of factories (Articles 4-15); control of special construction work (Articles 16-17); control of use of megaphones, etc. (Articles 18-21); sundry regulations (Articles 22-26); and penalties (Articles 27-30). Article 1 stipulates the objective of the Regulation to determine the necessary items concerning prevention of public hazards, besides the specific points provided for in Pollutions Countermeasure Fundamental Law (Law No. 132, 1967) to protect the health of the people of Osaka Prefecture and to maintain a living environment in a manner in harmony with the sound development of industry. Article 2, defining public hazards, mentions air and water pollutions, noise, vibration, and odor. Recording and reporting responsibilies of enterprises are stipulated. Appended to the regulation are a list of special facilities concerning sooty smoke, a list of special facilities concerning gas and dust, a list of special facilities concerning filthy water, a list of special facilities concerning noise, and a list of special equipment including some facilities which are omitted from the Regulations. The Osaka Prefectural Pollutions Prevention Regulation Enforcement Rule was issued on March 16, 1970, as Osaka Prefectural Pollutions Prefectural Rule No. 8, and was amended on July 3, 1970 by Osaka Prefectural Rule No. 65. Chapter topics are as follows: general rule (Articles 1 and 2); rules on factories (Articles 3-6); rules on special construction work (Articles 7-10); Rules on the us of megaphones (Articles 11-17); sundry rules (Articles. 18-20); and supplementary rules, stipulating necessary items in the enforcement of the Osaka Prefectural Pollutions Prevention Regulation, to become active from July 20, 1970. List 1 of the Appendix gives the standards on the control of noise generated by special construction work and List 2, items to be complied with in using megaphones.

29679

Chiba Prefecture (Japan), Pollutions Countermeasure Bureau

CHIBA PREFECTURAL ORDINANCE ON POLLUTIONS CONTROL AND ENFORCEMENT REGULATION OF ORDINANCE. (Chiba ken kogai boshi jorei, Chiba ken kogai boshi jorei seko kisoku). Text in Japanese. 58p., March 1970 and Sept. 1970.

The Chiba Prefectural Ordinance on pollution control consists of 42 articles, divided into general rules, basic measures concerning prevention of pollution, rules on smoke emission, the control of megaphone use, and sundry rules and penalties, with three articles of by-laws. In Article two, the definition of pollution is given as air and water pollution, noise, vibration, depletion of underground water, subsidence (except mining of ores), and obnoxious odors which cause damage to man's health or living environment (inlcuding property, animals, and plants, and their living environment, which has a close relationship with man). Soot smoke is sulfur dioxide which is emitted with the combustion of fuel, and other dust which is generated by fuel combustion and the use of electricity. The definitions of special facilities, special work and special construction work are given. The governors are required to determine pollution, to carry out research and survey for adopting necessary control measures, and to disseminate the knowledge for pollution control. When the control standard is to be set, changed, or revoked, the governor shall get the opinion of Chiba Prefecture Pollutions Countermeasure Council. Also, he must require those who emit soot and dust, when it harms human health or the living environment, to take necessary steps. He can make them report on necessary items such as the facilities emitting soot and dust, the control method, and the amount. His staff can inspect such factories, books, and facilities. The heaviest penalty for violation is less than one year prison term or less than $280 fine. The corporations, as well as those who were responsible for violating actions, are responsible. In the enforcement regulation, the special facilities are: those where SO is generated and emitted into the atmosphere exceeding 10 cu m/hr in terms O C temperature and 1 atm pressure; those which generate soot and other dust; and those which the governor recognizes to be in danger of generating pollution. The measurement record must be kept for three years. The mayors are responsible for some of the cities control business. Twelve types of facilities are given which emit soot and dust, with the scale and capacity; 9 types which emit harmful gas, dust, and odor are given.

29813

Chiba Prefecture (Japan)

POLLUTIONS PREVENTION PLAN FOR CHIBA AND ICHIHARA CITIES IN CHIBA PREFECTURE. (Chibaken Chiba, Ichihara chiiki ni kakawaru kogai boshi keikaku). Text in Japanese. 127p., Nov. 1970.

On May 27, 1969, the national government gave the Chiba prefectural government a directive to develop a plan for the prevention of pollutions for the Chiba and Ichihara area, based on the Pollutions Countermeasure Fundamental Law, showing the targets, because the area is expected to increase in population and to expand production facilities, with accompanying pollution increase. Consumption of heavy oil at present is 6,676,000 tons a year. Average sulfur dioxide for this area is 0.03 ppm, and out of 19 monitoring spots, 1 spot exceeded the environmental standard in 1969. In 1975, the consumption of heavy oil is expected to reach 27,700,000 tons, and if sulfur content in fuel remains the same, emitted SO2 will reach 160,000 tons. The following steps will be taken: in 1973, 30 enterprises which contribute to the peak pollution, will have a wind tunnel value of less than 0.015 ppm maximum on the ground, and the other enterprises will have less than 0.02 ppm; sulfur content of the fuel used shall be maximum 1.7% and the area average shall be less than 1.3%. In 1973, the total SO2 emission is to be less than 20,000 N cu m/hour; new chimney stacks are to be over 30 m and SO2 is to be collected; SO2 emitted from stacks taller than 70 m is to be 94.1%, to dilute and diffuse. Even at the worst condition with wind coming from the SSW, the complex concentration is to be less than 0.2 ppm. For new production facilities after 1973, the maximum ground concentration and degree of complex pollution are to be less than that of already existing industries. One hundred and twenty-four types of prevention equipment, including electric dust collectors are to be established by enterprises; steel mills are to emit dust of less than one third of the present level; steel mills shall remove mineral ore yard and coal yard to the reclaimed land area, and shall establish water sprinkling facilities. Also, [illegible] types of equipment, such as scrubbers, and 11 systems are to be installed at sources of obnoxious odors; and chemical plants within steel mills are urged to move to reclaimed areas. Thorough education and training of employees shall be established to prevent mishandling of equipment. Finally, enterprises near residences are to be removed with financial assistance.

29975

Smaller Enterprises Promotion Corp. (Japan)

CASTING WORK ENVIRONMENTS AND PUBLIC NUISANCE. (Chuzo sagyo kankyo oyobi kogai). Text in Japanese. In: Report of Field Survey on Technical Standards of Smaller Enterprises. Pig Iron Castings Manufacturing Industry (70-70) Chapt. Rept. 419, p. 57-69, March 1971.

The shortage of labor, caused by generally poor working conditions, is an increasingly serious problem for the casting industry. A survey revealed that 100% of the enterprises in the pig iron casting industry admitted the need to make working environment improvements. Changes should include: the development of work procedures, machines, tools, and equipment that will not damage the working environment; the improvement of ventilation, lighting, and air conditioning to eliminate dust, heat, noise, and odor; and the development of high-performance, low-cost devices to improve the working environment. According to the opinion survey, 774 out of 1762 companies wanted something done about dust, 386 about heat, 364 about noise, 129 about vibration, 82 about odor, and 27 about other items. Dust is produced by sand screening, demolition of molds, grinding, and melting in a cupola furnace. Heat occurs in teeming, especially hand-teeming, melting in a cupola, and demolition of molds. Noise comes from compressors, melting, molding machines, and grinding. Vibration comes from molding machines, grinders, cupola furnaces, and others, while odor is from mold-making, especially shell mold-making, carbon dioxide, melting in a cupola, and demolition of molds. Dust, noise, vibration, exhaust gas, odor, and effluents from the casting industry also cause a public nuisance. Since most casting works are smaller enterprises and located in densely populated districts, the solution of the public nuisance problem is very difficult, particularly for economical reasons. It can only be solved through the cooperation of central and local governments, enterprises, and local inhabitants. The most popular public nuisance prevention devices in the industry are dust removers and sound insulation devices, followed by the suspension of night-time operations. Now 75.4% of the enterprises operate during daytime only.

30149

Shigeta, Yoshihiro

RESEARCH ON ODOR ABATEMENT AND CONTROL IN U.S.A. (II). (Amerika ni okeru akushu no kisei to taisaku II). Text in Japanese. Akushu no Kenkyu (Odor Research J. Japan), 1(4):9-20, March 1971. 12 refs.

Odor measurement in Seattle with a scentometer, actual conditions of obnoxious odor in the Columbia-Willamette Valley, Portland and its control regulations, and the control regulations of Chicago, Cleveland, and St. Louis were described. The kraft paper mill in the Puget Sound produces 325 tons/day of kraft paper with 9 digesters. The odor is a problem in the residential area about 6 km to the east of the kraft pulp mill, and its white smoke can be seen 30 km away. An electric dust collector was installed the recovery boiler was modified in 1968. By 1975, 98% of dust and more than 99% of odor will be eliminated. At present, the odor of the noncondensable gas is drawn out by fans and is burned by atomizing the oil burner at over 1000 F. The rest of the odor is eliminated by the Los Angeles formula. The Puget Sound Air Pollution Control Agency carries out wide range of air pollution control activities. A scentometer and the iodimetry method are being used for odor control. The Columbia-Willamette Air Pollution Authority consists of 5 counties and has 8 air pollution monitoring networks. One-third of the complaints it receives from the citizens were on obnoxious odors, but very few enterprises actually violate the pollution control regulations. Portland, as well as Los Angeles, is one of the few areas which made the installation of deodorizing devices compulsory. Chicago makes it a violation of the Air Pollution Control Law to emit soot, fly ash, dust, and embers within 1.6 km of the city. Cleveland's Air Pollution Control Law forbids the emission of harmful, poisonous, irritating odors, fumes or other pollutants from chimneys. In St. Louis, no one should emit obnoxious odors which are unpleasant to the people. In the industrial area or its neighboring areas, no odor of more than 20 Odir units is to be emitted, as measured with an olfactometer. When more than 30% of the residents in a residential area suffer unpleasant odors, such an odor is regarded as environmental pollution. No rendering factory can be operated without deodorizing in an approved manner.

30153

Morita, Minoru

REPORT ON THE BASIC RESEARCH CONCERNING THE ADMINISTRATION OF ENVIRONMENTAL POLLUTION AT HEALTH CENTERS. (Hokensho ni okeru kogai gyosei ni kansuru kisoteki chosa kenkyu, hokokusho). Text in Japanese. Research Committee on the Administration of Environmental Pollution at Health Center (Japan). 189p., 1968.

The actual condition of the administration of environmental pollution was studied with questionnaires. From January to December 1968, 832 nationwide health centers and organizations related to pollution problems in 46 prefectures and seven main cities were questioned, and 86.2% of the health centers, 93.5% of the organizations in 46 prefectures and 100% of those in seven cities replied. The number of the cases of complaints and petitions per year varied with cities and prefectures: there were 2648 cases in Osaka, which was the highest; 2613 cases in Tokyo; and 1116 cases in Hagoya. The content of the complaints and petitions received by the organizations differed from those received by health centers. Problems of air pollution and water pollution tend to be received by the former and bad odor and other pollution problems by the latter. The health centers found the pollutants, in most cases, through residents reports and 64.16% experienced the problems of pollution. The investigation of pollution varied with the anti-pollution measures used by each health center. However, Osaka and Kanagawa had the most cases per year (65), while Kyoto was second with 53 cases. At health centers in areas where soot and smoke is controlled, a considerable number of complaints and petitions mentioned not only air pollution, but also other pollution. In order to know more regarding the organized activities for anti-pollution measures, actual organizations and examples of investigations, in Mie Prefecture, Yokohama City, Kawasaki City, Tokyo, Shizuoka Prefecture, Sakai City, and Chiba Prefecture are listed.

30688

WHAT KIND OF ADMINISTRATION SHOULD BE PRACTICED FOR POLLUTION CONTROL AT PREFECTURE LEVEL? (Todofuken ni okeru kogai gyosei no arikata (Dai 1 po)). Text in Japanese. 224p., 1970.

The conditions of administration in pollution control, especially the activites of health centers were studied. All the prefectures and 25 special cities in Japan were objects of the study. The areas investigated include: kinds of pollution, regulations for pollution control, administrative procedures, organizations of departments or sections in charge, related research organizations, cases of pollution problems which were disposed of based on relevant laws or regulations, and non-governmental activities. In the research organizations, the activity and career of personnel in full-time duty were examined. In health centers complaints about pollution, disposition of the problem, and demands for activity were studied. Air pollution, water pollution, noise, vibration and offensive odors were reported by all the prefectures and cities. Though ground shrinkage was reported by 21 prefectures and nine special cities, industrial wastes were treated as pollutants only by three prefectures and six cities. There were nine prefectural institutes, or centers, on pollution research. However, in almost all the prefectures and cities, studies were done by the institutes of public health. Personnel in medicine are desirable for full-time service, as well as scientists and engineers. At the health centers near cities, only one person for five health centers was in charge of pollution problems, regardless of many complaints. In spite of the increase in pollution problems with the development of industrialization, administrative activity concerning pollution was underdeveloped at health centers in agricultural and fishing villages. The number of intermediate-type health centers belonged between the above mentioned two types, and was only one-tenth of the total number of health centers in Japan. Their activities and instruments for measuring pollutants are efficient. Residents are highly concerned about pollution problems, and since the number of complaints will increase in the future, accomplishment of activities at health centers is urgently needed.

31084

Shaw, F. M.

IRONFOUNDRIES AND THE REQUIREMENTS OF CLEAN AIR LEGISLATION. Iron Steel (London), 44(3):183-188, June 1971. 4 refs.

Regulations covering emissions from iron foundries and available preventive measures are summarized. The emissions include grit, dust, fume, smoke, and sulfur dioxide from cold and hot blast cupolas, smoke and odor from core-making and mould pouring operations, and dust from cleaning and fettling operations Among cupolas control measures discussed are dispersion from tall stacks, combustion in cupolas, and wet and dry arrestors. Exhaust hoods and tall stacks appear feasible in controlling odorous smoky gases from core stoves. Combustion may also have possible applications for core stoves. Requirements of fabric collectors for metallic dust are noted. Cost data are presented for most of the control measures.

31465

Wrist, P. E.

IMPACT OF NEW AIR POLLUTION REGULATIONS ON THE PULP AND PAPER INDUSTRY. Tappi, 54(7):1090-1093, July 1971. (Presented at the Technical Association of the Pulp and Paper Industry, Water and Air Conference, Boston, Mass., April 4-7, 1971.)

The Clean Air Act of 1970 departs from the trend of previous legislation in that it places emphasis on emission standards and emission monitoring, coupled with speedier processes of enforcement to improve air quality. Implications of this act upon the pulp and paper industry are explored. The importance of participation in standard settings is emphasized, together with the need for development of better instrumentation and an understanding of the effect of normal operating variables on the level of odor emission. The technical person can have a major influence on the economic impact which the new act will have on industry. (Author abstract)

32147

Colorado State Dept. of Public Health, Denver, Air Pollution Control Section

COLORADO AIR POLLUTION CONTROL. 75p., 1969.

The Colorado State Health Department feels that the concept of preventive action takes precedence over action based only on proven adverse effects; maximum control, utilizing existing technology, takes precedence over delay until technology develops; stringent emission control at the source takes precedence over the use of the atmosphere to dilute the air contaminants; and conservation and non-degradation of air resources takes precedence over delay and apathy until the problem develops. Proposals for changes in 1970 legislation were listed. Ambient air standards, emission standards, nuisance prevention, emission notices, a variance board, and adequate budgetary appropriations were considered. Enforcement activities were described. Six air pollution control areas were established. Open burning was curtailed; positive court actions were upheld by the State Air Pollution Control Act. Smoke emission limitations against automobiles and trucks are being enforced. Legal aspects of air pollution control in Colorado were also discussed. An emission inventory was made, and an air monitoring program was established. Emission inventory classifications are given for particulates, carbon monoxide, hydrocarbons, nitrogen oxides, sulfur oxides, and aldehydes. The stations are listed by designated air pollution control data, the sampling period involved, and the number of samples taken. The data from each station are presented. An odor survey and tracer study were also conducted. Public education is also being enhanced. Meteorology, wind, diffusion models, and inversions are also discussed.

32171

Reno, Sparks, and Washoe County District Board of Health, Nev.

AIR POLLUTION CONTROL REGULATION. 24p., Sept. 18, 1969.

Air pollution control regulations are presented for the cities of Reno and Sparks and Washoe County. General terms are defined and the powers and duties of the Board of Health are delineated. Emission standards are derived for visible air contaminants, odorous or gaseous emissions, particulate matter, sulfur compounds (sulfur dioxide), combustion contaminants (carbon dioxide), scavenger plants, dusts, fumes, open fires, incinerators, sulfur content of fuels, gasoline loading and unloading, storage of petroleum products, and sand. Registration requirements and penalties for violations are included.

32352

Gainer, J. G.

CANADIAN AIR POLLUTION REGULATIONS AND THE SOUR GAS PROCESS INDUSTRY. Proc. Nat. Gas Processors Assoc., vol. 48-93-96, 1969. 7 refs. (Presented at the Natural Gas Processors Association, Annual Convention, 48th, 1969.)

The evolution of air pollution control in the natural gas sulfur recovery industry in Alberta is reviewed, in the light of legislation and industrial developments which led to the Public Health Act and the Oil and Gas Conservation Act. Most control legislation is provided by regional governments; a small amount is provided by the federal government. In 1945, the first legislation was enacted in Alberta to evaluate complaints and to remedy the conditions where necessary. Later legislation governed the control of dust from piles of coal and slag, the authority to make regulations, the control of pipelines, and the control of new construction. Emission standards were established for smoke in urban and rural areas (with the Ringelmann chart), particulates, odors, and toxic materials. The Alberta Department of Health used two approaches to the general problem: the control of pollution at the source; the control by dilution in the atmosphere (tall stacks, meteorological control of process operations, and effective zoning). Air quality criteria were developed for sulfur dioxide, hydrogen sulfide, and sulfur trioxide for short and long terms and for populated and remote areas. All construction must be approved and monthly reports of atmospheric monitoring, plant operations, incinerator stacks, flares and flare pits must be made. Odors are controlled by incineration, pilot flames, settling ponds, vapor recovery, or weather. Comparative sulfation rates show improvement in air quality since the Health Regulations took complete effect.

32354

Nordrhein-Westfalen Arbeits-und Sozialminister (West Germany)

PLANS AND GOALS OF THE STATE GOVERNMENT TILL 1975. (Plaene und Ziele der Landesregierung bis 1975). Text in German. In: Reinhaltung der Luft in Nordrhein Westfalen. Essen, West Germany, Brinck and Co. KG, 1969, p. 84-93.

The state government has adopted a new regional approach to all pollution control planning. Abatement programs instituted for Thomas steel converters, ore sintering plants, cokeries, foundries, and steam power plants will terminate in 1973. In selected industrial centers with high pollution emissions, all industrial, domestic, and automotive polluters will be rechecked and results of the survey will be used as a basis for pollution control improvement and for planning and legislative purposes. An emission register (map) of Cologne, Duisburg-Oberhausen-Muelheim an der Ruhr, Essen-Bottrop, Gelsenkirchen-Wanne/Eickel-Bochum, Gastrop-Rauxel, and Dortmund will be compiled and used for purposes of pollution forecasting. Measurement data show that chemical and petrochemical plants contribute an inordinately large share to overall pollution; these plants will have to install new equipment to reduce emissions of concentrated reaction gases, odorous gases, and gases with high particulate content. New monitoring programs will be instituted for fluorine, hydrocarbons, odorous sulfur and nitrogen compounds, hydrogen chloride, and oxidants and particulates in an area extending from Cologne to Dortmund. New regulations will be issued governing maximum permissible emissions from all domestic heating plants fired by oil, coke, or coal. The incineration of solid waste in heating plants will be prohibited.

32382

Pima County, Air Pollution Control District, Ariz.

RULES AND REGULATIONS. SUPPLEMENTING ORDINANCE NO. 1967-10. 22p., Dec. 23, 1968.

Rules and regulations on air pollution emissions and control are reviewed for Pima County. General terms and standard conditions are defined. Permits, fees, and fee schedules are determined. Emission standards are designated for visible emissions, particulate matter, emissions of gases, vapors, fumes, or odors, storage and handling of petroleum products, maximum allowable concentrations of sulfur dioxide, sulfuric acid, sulfur trioxide, and hydrogen sulfide, and open burning. Emergency procedures are outlined.

32383

Clark County District Board of Health, Nev.

AIR POLLUTION CONTROL REGULATIONS. 29p., April 22, 1970.

Air pollution control regulations are reviewed for Clark County. General pollution terms are defined and the organization of the Air Pollution Control Board, its powers, and duties, are determined. The registration and inventory of sources of pollution emissions, items requiring a registration certificate, and fees are listed. Standards are evolved for open burning, incinerators, visible air contaminants, particulate matter, dust and sand control, gasoline unloading, storage of petroleum products, and odors in the ambient air. Penalties and costs for violations are included.

32566

Hemeon, Wesley C. L.

MALODORS - A BASIS FOR REGULATIONS. Preprint, Air Pollution Control Assoc., Pittsburgh, Pa., 24p., 1971. 3 refs. (Presented at the Air Pollution Control Association, Annual Meeting, 64th, Atlantic City, N. J., June 27-July 2, 1971, Paper 71-21.)

Of the four major categories of objectionable air pollution effects, climatic modification, hazards to health, injury to vegetation, and sensory offenses, the last is considered to be of dominant importance, and should receive higher priority in governmental policy. This particularly applies to malodors. This deficiency may be partially due to the pre-eminent emphasis on the search for health effects and partly to the problems of measurement of malodors. Odors can be measured at the source with satisfactory precision by collecting odor--contaminated air in a large polyethylene bag and subjecting it to an odor meter for evaluation. Ambient air quality can also be evaluated by a simple technique and with nontechnical personnel. A sample of ambient air is taken into a plastic bag during a one-minute sampling period and is then taken to another location for evaluation by a panel of impartial persons. A compatible system of an ambient air quality standard and allowable emission rates from sources is demonstrated, and the essential elements of an odor control regulations are described. (Author abstract modified)

32626

Wilson, Edwin B.

CURRENT AND PROPOSED REGULATIONS AND LEGISLATION ON AIR POLLUTION CONCERNING THE APPALACHIAN COAL INDUSTRY. Preprint, American Ins of Mining, Metallurgical, and Petroleum Engineers (AIME), New York, N. Y. 31p., 1969. 7 refs. (Presented at the American Institute of Mining, Metallurgical and Petroleum Engineers, Annual Meeting, Washington, D. C., Feb. 19, 1969.)

The implications of air pollution control in the Appalachian region of the United States will be felt most strongly by the coal industry of this area. Directly or indirectly, most regulations in these states have a significant bearing on coal mining, processing, utilization, or waste disposal. In the Appalachian area, typical state law establishes a separate air pollution control authority and specifies its membership. Regulations are generally brought into effect by cooperation with industry. Regulations are not uniform from state to state; they vary from no regulation at all to strict limits on the sulfur content of fuel. Emissions of particulate matter are controlled by measurements with the Ringelmann Smoke Chart. Regulations may also place limitations on open burning, particulate matter emission, gaseous matter emission, objectionable odor, and dust. The air pollution control laws of West Virginia, Pennsylvania, Maryland, Virginia, Kentucky, and Tennessee, and how they apply to the coal industry, are given. All organizations with an existing or potential air contamination source should become thoroughly familiar with all organizations, legislation, and regulations of concern to their operation.

32796

Wada, Masaru

ON ENACTMENT OF OFFENSIVE ODORS CONTROL LAW. (Akushu boshiho no sentei ni tsuite). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 7(9):780-787, Sept. 1971.

The statistics of complaints made against bad odors in 1969 indicate that 38.0% of the total was made against stockfarming, animal offal treatment and fishmeal plants; 36.6% against oil chemical factories and Kraft pulp mills; and 8.6% against sewage treatment plants and waste disposal incinerators. Detailed tables of statistics are included. The Odor Control Law, issued on June 1, 1970, its purpose, odor producing materials, definition of odor producing areas, and other items in the law are reviewed. Currently available deodorizing methods include the gas cleansing method, effective for water, ammonia, low molecule amines, low molecule fatty acids, acidic alkalines, hydrogen sulfide, mercaptans, sulfides and high molecule amine fats, applicable to agriculture and stockfarming, sea products manufacturing, and urban sanitation facilities. The ozone oxidation method is effective for nonsaturated organic chemicals, hydrogen sulfide, mercaptans, amines, aldehyde-sulfides and is applicable to sewage treatment plants. The direct combustion method is effective for oil refineries and oil and fat treatment factories. The catalytic oxidation method is effective for hydrocarbons and applicable to paint-varnish solution mixing, oil-fat processing, pharmaceuticals, resin manufacturing, animal cadaver incinerators, and sewage treatment plants. The adsorption method is effective for alcohols, fats, acids, benzene, mercaptans, and oil, applicable to fishmeal plants, fertilizer plants, pharmaceutical plants, propane gas filling plants, and vacuum cars. The air oxidation method is good for hydrogen sulfide and is used at oil refineries. The soil oxidation method is good for ammonia and amines, and is applicable to poultry farms. The ion exchange resin method is effective for sewage treatment plants.

32893

Hattori, Taira

OFFENSIVE ODOR CONTROL ADMINISTRATION TODAY AND TOMORROW. (Akushu kogai gyosei no genjo to tenbo). Text in Japanese. Yosui To Haisui (J. Water Waste), 13(8):957-961, Aug. 1971.

The provisions of the Offensive Odors Prevention Law in Japan, enacted June 1, 1971, and the controversies surrounding it are reviewed. The law designated criteria to control respective substances contributing to offensive odors but not the odors themselves, since unpleasant odors are generally a complex combination of two or more odorous components. The sources of the offensive odors (oil industry, paper pulp industry, stock raising) are easily specified, and the representative odor generating substances are also easily determined; control of these substances, e.g., methyl mercaptan or ammonia, effects a control of the odors. Controls of specific components rather than general odors are more effective with respect to legal factors. Evaluation of an offensive odor by a human panel is not irrefutable evidence in a law suit, but instrumental analysis of a known odor-causing substance is accepted.

33117

Ishiguro, Tatsukichi

PROBLEM OF ODOR CONTROL LAW. (Akushu boshi ho no mondaiten). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 7(9):789-792, Sept. 1971. 20 refs.

An Odor Control Law was issued on June 1, 1971, at the 65th session of the Japanese Diet. Characteristically, the subject of the odor control enforcement is not specific emission sources such as boilers, furnaces, or apparatus, but the entire plants which contain these sources (sanitation plants, sewer treatment plants, slaughter houses, and stock farms), regardless the scale of their operations; when a prefectural governor declares odor control areas, he is to consult with the heads of cities, towns and districts; these heads in turn are able to request the governor to declare odor control areas where they feel necessary. Three general criteria are applied to a place of operation under inspection: determination of the maximum allowable concentration of odor producing material at the boundary of the facility and the outside; regulation of the concentration of odor producing material at the emission source so that the concentration rate would be same as the first criteria; and the concentration of odor producing material evaporating from polluted liquid discharge should be same as the first criteria. The maximum permissible concentration figures are to be within the limits set by the National Pollution Control Agency, and determined by respective local administrative bodies on each of 13 odor producing elements, according to the area s climatic social, and topographical conditions. The most serious limitation of the law is its designation of only 13 odor producing materials as objects of control, and the basic outlook that regulation of their concentration in the air rather than the source would solve the problem. While there is no objective way of evaluating odor nuisance, nor sufficient data for effective legalization of odor control, the matter of odor should be handled separately from area pollution by organic and inorganic gases.

33672

Henz, Donald J. and Richard W. Gerstle

THE PLANT ENGINEER AND AIR POLLUTION CONTROL. Factory, 4(10):35-36, Oct. 1971.

A plant engineer should know the effect of the Clean Air Act and generic types of emission control regulations. The Act effectively brings every area in the U. S. within the scope of air quality management. It gives the administrator of the Environmental Protection Agency the right to publish regulations giving ambient air quality standards including emission or equipment standards. These performance standards are applicable to all sources constructed or modified after promulgation of the standards. The operator of a new or modified source can be required to keep records, make reports, and monitor and sample for emissions. His plant can be entered for inspection and testing of the exhaust stream. Where a state fails to enforce emission standards, the Clean Air Act provides for federal enforcement. Generic types of regulations pertain to particulate matter, gaseous emissions, odor, visibility, and equipment specifications. New particulate regulations are based on the total allowable amount emitted per hour. The allowable rate is determined by the types of control equipment available for various sources or types of combustion sources in an area. Gaseous emission rules vary according to area problems. Thus, in cities where large amounts of coal or oil are burned, the emphasis is on sulfur dioxide. Since visibility regulations do not present a quantitative emission limit, they are among the most difficult for the plant engineer.

33725

ODOR CONTROL LAW--JUNE 1, 1971, NO. 91. (Akushu boshi ho-Showa 46 nen 6-gatsu 1-nichi, Horitsu dai 91 go). Text in Japanese. Kogai to Taisaku (J. Pollution Control), 7(9):829-831, Sept. 1971.

Odor Control Law 91, Effective June 1, 1971 in Japan, is examined. The purpose of the law is the maintenance of a healthy living environment by controlling emissions of offensive odors from factories and other sources. Bad odor is defined by law as material causing unpleasant odor, and includes ammonia and methyl mercaptan, along with other materials designated by ordiances. The prefectural government has the responsibility of designating the areas that come under control surveillances; setting standards of odor control and measurement methods, issuing odors for improvement; determining procedures of inspections and reports; and enforcing regulations and orders. Governors are to decide in these matters on the advice of city, township, and village governments in the specific areas subjected to odor regulations and in areas adjacent to those subject to surveillance. Violators of an improvement order issued by the governor are subject to less than one year of incarceration or a fine of less than $300, after an advisory period of appropriate length. Those who fail to submit reports, submit false reports, or decline or obstruct an inspection under such orders, are subject to a fine of less than $100.

34033

Bermingham, P. E.

CURRENT EMISSION STANDARDS AND THE PETROLEUM INDUSTRY. American Petroleum Inst., New York, Div. of Refining, Proc. Am. Petrol. Inst. Div. Refining, vol. 51:587-610, 1971. 86 refs. (Presented at the Midyear Meeting, 36th, San Francisco, Calif., May 12-14, 1971.)

Environmental laws and regulations applicable to petroleum refining are discussed from a legal point of view. Effluent discharges as affected by the Water Pollution Control Act and its amendments are discussed, as well as oil spills affected by the Water Quality Improvement Act of 1970 and impediments to navigation affected by the Refuse Act of 1889. Pending 1971 water pollution amendments are indicated. Refinery emissions into the ambient air as affected by the Clean Air Act and its amendments are considered. National standards are cited for major pollutants and new stationary sources. Fuel composition including lead in gasoline is discussed. Citizens suits, noise, odors, flares and glares, and thermal pollution are mentioned. (Author abstract modified)

34256

CLEAN AIR FOR CALIFORNIA. (SECOND REPORT). California State Dept. of Public Health, Berkeley, 24p., March 1956.

To carry out the responsibility assigned by the 1955 Legislature, the California State Department of Public Health has undertaken environmental and medical investigations. These projects are to evaluate the effects of air pollution on health; determine the factors responsible for air pollution; survey air pollution throughout the State; monitor pollutants, and assist local agencies concerned with air pollution. Efforts are made to coordinate the activities of other governmental agencies and to assure that necessary research is undertaken and effective control programs planned. Also mentioned are smog, preventive health, mortality temperature-smog alert correlations, respiratory diseases, lung cancer, odors, and oxidants.

34755

Partee, Frank P.

AIR POLLUTION CONTROL IN KENTUCKY - THE SURPRISE STATE. Vanderbilt Univ., Nashville, Tenn. Dept of Environmental and Water Resources Engineering, and Tennessee Stream Pollution Control Board, Environ. Water Resources Eng. Conf., 9th, Annu., Nashville, Tenn., 1970, p. 1-19. 6 refs. (June 4-5.)

Population statistics and the topography and meteorology of Kentucky are reviewed. Sources of air pollution include motor vehicles, jet aircraft, open burning, and a wide variety of industrial process emissions, including steel mills, foundries, aluminum refineries, chemical plants, petroleum refineries, charcoal and coke plants, asphalt plants, cement plants, paper mills, and extensive mineral production. Unique odor problems occur from the numerous tobacco curing sheds and warehouses. The Air Pollution Control Commission, established in 1966 under the Kentucky Air Pollution Control Law, consists of 13 members including heads of the Departments of Health, Commerce, Natural Resources, and Agriculture, and the Attorney General. Of the eight appointed members three represent industry; three, the general public; and one each, the University of Kentucky and a local control agency. The Technical Services section is responsible for data processing and air monitoring. Field Enforcement Services obtains compliance with regulations, and Engineering Services oversees source registration, emission inventories, development of emission standards, and consultative services. Intergovernmental operations are discussed. Future developments in the Kentucky air pollution control program may include additional emission standards for sulfur oxides and solvent vapor emissions. Motor vehicle air pollution control device inspection will be tied to proposed state safety inspection programs.

34926

Coordinating Research Council, Inc., New York, Air Pollution Research Advisory Committee

APRAC STATUS REPORT. 109p., Jan. 1971.

The Coordinating Research Council's research program on automotive air pollution is being accomplished with support from the automotive industry, the petroleum industry, and the Government. Summaries are presented of engineering projects which explore the interactions between petroleum products and the automotive equipment in which the products are used, atmospheric projects aimed at explaining pollutant behavior in the atmosphere, and medical projects to determine the effect of emissions upon health. Exhaust odor, combustion processes within engine exhaust systems, automotive fueling emissions, driving patterns, instrumentation for nitrogen oxides and oxygenates in exhaust gas, methods for analysis of particulates and polynuclear aromatics, inspection, maintenance, surveillance, and economic effectiveness, and characterization of particulates versus fuel composition are some of the engineering projects outlined. Atmospheric projects include chamber reactivity, plant damage, a diffusion model of the urban atmosphere, the fate of carbon monoxide, light hydrocarbons in the atmosphere, haze formation, and atmospheric pollutants in the urban air. Medical projects have included the exposure to carbon monoxide, nitrogen oxides, oxidants, and polynuclear aromatic hydrocarbons, and synergistic effects.

35511

Ministry of International Trade and Industry (Japan), Agency of Industrial Science and Technology

INDUSTRIAL POLLUTION CONTROL TECHNICAL RESEARCH BASIC PLANS (PILOT PLANS). (Sangyo kagai boshi gijutsu kenkyu kihon keikaku (shian)). Text in Japanese. 17p., 1971.

Various projects on industrial pollution control to be conducted by various institutions under the Agency of Industrial Science and Technology, Ministry of International Trade and Industry are reviewed in a table form for 1971. Research themes, brief descriptions of projects, purposes, and organizations in charge are given. Projects concerning automotive emissions include: methods of testing engine exhausts, methods for analysis of aldehydes, the influences of exhaust gas on air pollution, improvement of fuels, and the development of catalytic converters, small high power diesel engines, and lithium batteries. Projects concerning emission control of nitric oxide from stable combustion sources include: research for controlled combustion techniques, methods of elimination of toxic matter from stack gases, and development of catalysts. Studies on stack gas dispersion include: on-site turbulence mechanism, simulation with wind tunnels, and simulation using computers. Studies concerning measurements include: development of toxic gas analyzers, dust particulate measuring methods, and odor component measuring methods.

35694

Gray, Albert Woodruff

LEGAL ASPECTS OF AIR POLLUTION. Air Eng., 4(3):29-31, March 1962. 5 refs.

Case histories were given to answer legal questions about when an odor constitutes an actionable nuisance. A permit is no legal sanction for conducting a business that is a public nuisance. In California, the legal use of the Ringelmann chart was established; it says a person shall not discharge smoke or contaminants as dark or darker in shade than that designated No. 2 on the Ringelmann chart. Smoke from ships is in the province of local governments. Congress recognized that the problem of air pollution is a matter of state and local concern. A court maintained that there is no overlap between the scope of the federal ship inspection laws and that of municipal ordinances.

35752

Ishiguro, Tatsukichi

THE DIRECTION OF ODOR CONTROL AND REGULATIONS. (Akushu kogai no genjo to kisei no hoko). Text in Japanese. Japan Society of Efficiency, Tokyo, Chem. Plant Eng. Conf. Proc., Tokyo, Japan, 1971, p. 2-1-1 - 2-1-17. (Oct.)

Some difficulties and trends of odor control methods are examined. The lack of objective methods for evaluating odors and established method of analysis; the complex composition of odors; effectiveness of control methods, which demands the elimination of more than 99.9% odors; costs; and distribution methods are discussed. The function of the control agency include the designation of offensive odors, their sources, control methods, and standards for concentrations. The entire industry, as opposed to a specific source, and the entire classification, as opposed to the individual operation, must constitute the objects of control. Before establishing future policies, the designated 13 odor-producing materials should be re-examined; measurement methods, limited to the low-temperature condensation method and gas chromatography, must be evaluated and expanded; the role of local opinion and government agencies, with respect to standards, laws, enforcement procedures, and financial measures, must be investigated. Data on complaints of offensive odors and odor sources are presented.

M. SOCIAL ASPECTS

00376

N. Z. Medalia

AIR POLLUTION AS A SOCIO-ENVIRONMENTAL HEALTH PROBLEM: A SURVEY REPORT. J. Health and Human Behavior 5, 154-65, 1964.

An attempt has been made to explore the behavioral variables of situation-defining in relation to a specific environmental stress, sulfate odors associated with kraft pulp mill operation. The results of this study are presented because of the methodological and conceptual implications relative to social science research on environmental health problems. The following topics are discussed: Awareness of and concern with air pollution; community satisfaction and concern with air pollution; analysis of action potential with reference to environmental stress; ecological and social status variables in air pollution awareness and concern; and air pollution as an ecosystem variable.

00487

J. J. Sableski

COMMUNITY ODOR SURVEYS AND EVALUATION. Preprint. (Presented at the Mid-Atlantic States Section Meeting, Air Pollution Control Association, Wilmington, Del., Nov. 1965.)

Typical objectives of an odor survey are listed. The components of an odor survey are described as selecting observers, evaluating their sensitivity, making odor measurements, and obtaining background information on meteorology and sources. The conduct of an actual survey is described and methods for analyzing the data given. (Author abstract)

00844

N.Z. Medalia

COMMUNITY PERCEPTION OF AIR QUALITY: AN OPINION SURVEY IN CLARKSTON, WASHINGTON. Public Health Service, Cincinnati, Ohio, Div. of Air Pollution. June 1965. 106 pp. GPO: 820-365-9, HEW: 999-AP-10

In a community with a population of 7,000 and located approximately 4 miles downwind from a pulp mill, a public opinion survey was taken to analyze the environmental stress of air pollution on a sample of household heads and spouses, along two principal attitudinal dimensions: awareness and concern. Of those interviewed, 91% perceived air pollution in the community as a malodor problem; 74% perceived it as a problem of visibility; and 62% as a problem of nose-throat irritation. A Guttman-type scale showed high concern with air pollution among 48% of the sample; low to moderate concern among 31%; and minimal concern among 21%. Although exposure ot odorous pollutants in ambient air appeared roughly equal for all members of the sample, their concern with air pollution was found to vary directly with social status and attitude characteristics such as civic pride, desire to ameliorate the situation, length of residence in the community, and occupational prestige of the household head. (Author abstract)

01069

W.S. Smith, J.J. Schueneman, L.D. Zeidberg

PUBLIC REACTION TO AIR POLLUTION IN NASHVILLE, TENNESSEE. J. Air Pollution Control Assoc. Vol. 14(10):418-423, Oct. 1964. (Presented at the Annual Meeting American Industrial Hygiene Association, Cincinnati, Ohio, May 5-10, 1963.)

Extensive air pollution studies have been completed in Nashville. One part of the study involved collection of opinions from nearly 3000 people. Opinions were solicited relative to awareness and concern about possible adverse effects of air pollution on health, property, materials, and aesthetics. Responses of the interviewed people are related to several types of pollutant measurements. The results indicate widespread concern about air pollution, and the degree of concern is, in general, closely related to the degree of air contamination experienced by interviewed people. Methodology is discussed, data are analyzed statistically, and conclusions are presented. (Author abstract)

08698

Nelson, Bryce

AIR POLLUTION: THE 'FEDS' MOVE TO ABATE IDAHO PULP MILL STENCH. Science, 157(3792):1018-1021, Sept. 1, 1967.

A major inversion occurred in 1959; one resident recalls it as 'the black night.' After such incidents, more citizens protested, and the mayor of Lewiston created a committee on air pollution. In Nov. 1960, the mayor of Clarkston wrote to the chief of the Division of Air Pollution of PHS to request help in abating an interstate air-pollution problem said to be principally caused by the PFI mill. In response to this request, the PHS initiated several meetings with local and state authorities and began a study of air pollution in 1961-62. The PHS study indicated that Lewiston and Clarkston had a common air mass and that either city could pollute the air of the other. The PHS report stated that 50 percent of the physicians in Lewiston and Clarkston had been interviewed and that a large majority of the physicians stated that they concurred in their patients' belief that certain of their disease conditions were related to air pollution and that several noted improvement in patients with respiratory conditions when the patients moved from the area of high pollution or used air conditioning. Included in the PHS-study was an opinion survey conducted in 1962 about community perception of air quality in Clarkston. Nearly 80 percent of those interviewed said that their city was affected by air pollution, and almost two-thirds stated they were bothered by it to some degree. More than 90 percent who recognized air pollution as a problem first mentioned the pulp mill as being among the sources of such pollution. In March of this year, a conference on the areas air pollution was held in Clarkston. The conference provided many area citizens with an unparalleled opportunity to voice their frustration about the condition of their local atmosphere.

13980

Nishiyama, Keitaro, Mitsuyoshi Nagayasu, Takeo Azuma, and Masaichi Ishizawa

STUDIES OF THE PREVENTION OF PUBLIC NUISANCE BY THE EXHAUST GASES FROM THE KRAFT PULP MILL. PART 3. INFLUENCES OF ODOR ON N-AREA INHABITANTS. (KP seishi kojo haigasu no kogai boshi ni kansuru kenkyu dai 3 ho kojo shuhen no shuki ni taisuru jumin no hanno ni tsuite). Text in Japanese. Shikoku Igaku Zasshi, (Shikoku Acta Medica), vol. 24:43-52, 1968.

A survey of bad odor was undertaken in the area within 6 km of a kraft pulp mill labeled the N mill. Of 749 inhabitants, 87.8% recognized the bad odor and most referred to the mill as its source. A number of people found that the odor existed throughout the year. This is due to the unstableness of the wind direction in the area. Approximately 29% of the inhabitants were forced to close the windows and doors and 52% of that group said they failed to get rid of the odor. The chief complaints of the inhabitants were unpleasantness, mental oppression, meals not enjoyed, disturbed reading and work, and respiratory disorders. Comparative studies of locations in different directions and distances from the mill did not show clear differences. (Author abstract modified)

14491

Ohira, M., H. Maruya, and T. Nagira

A STUDY OF AWARENESS AND OPINION OF THE RESIDENTS ABOUT PUBLIC NUISANCES IN MIZUSHIMA (NEWLY DEVELOPED INDUSTRIAL AREA). (Mizushima chiku jumin no kogai ni tsuite no ishiki jokyono chosa). Text in Japanese. Nippon Eiseigaku Zasshi (Japan J. Hyg.), 24(1):99, April 1969.

Air pollution has been intensified in Mizushima, due to the introduction of the steel and oil industries. A survey of subjective symptoms and opinion on air pollution was conducted among 182 households in the area regarded as most polluted (called area A) and 88 households in apartments owned by one of companies regarded as a polluter in this area (area B). Complaints such as eye irritation, frequent coughing and expectoration, and malodorous air were heard more frequently at A than at B. People from area A, who once welcomed the introduction of industry, are much more displeased with it than people from area B, who belong to the industry. However, the former are becoming reconciled to this pollution. They do not believe that the local government or industry will control air pollution. Furthermore, they have little confidence in the ability of a civic association to eliminate public nuisances and would rather move out of the area than oppose pollution. On the other hand, people working in the offending industry pay little attention to nuisances. It is concluded that the opposition of residents to public nuisances should be supported by physicians, scientists, and other actively concerned persons.

15760

Lindvall, Thomas

THE NUISANCE EFFECTS OF AIR POLLUTANTS. (Luftfoeroreningars olaegenhetseffekter). Text in Swedish. Nord. Hyg. Tidskr. (Stockholm), no. 3:99-115, March 1969. 11 refs.

Annoyance reactions from odorous and particulate air pollutants were regarded as medico-hygienic problems in Sweden. Legislation in Sweden permits intervention based solely upon subjective annoyance reaction to some extent. Nuisances from industrial plants are usually caused by odors and particulate matter. Complaints were reported in 78% of urban and 27% of rural communities. The medico-hygienic evaluation of nuisance from air pollution includes studies of the dose-response relationship between the pollutant in the ambient air and the extent and strength of the annoyance reaction. The description of the dose is often complicated by the fact that many odorous substances are hard to detect while they still have odor. Therefore, the concentration in the ambient air is often based upon analysis at the source combined with meteorological spreading calculations. From a statistical point of view, there is often a satisfying correlation between predicted and actual concentrations in the ambient air. The organoleptic principle of analysis of odorous emission was used more frequently during the last few years. Odor threshold determinations were successfully used in testing odor abatement equipment and in dose description around pulp mills. The frequency is calculated by which a certain concentration is exceeded at different distances from the source. The description of the dose was satisfactorily worked out by the use of standardized, sociological inquiries with special attention to certain effects of interaction, such as disquising of or differences in attitude. Response studies were undertaken in Sweden around pulp mills and oil refineries. (Author summary modified)

23408

Springer, Karl J. and Charles T. Hare

A FIELD SURVEY TO DETERMINE PUBLIC OPINION OF DIESEL ENGINE EXHAUST ODOR. (FINAL REPORT). Southwest Research Inst., San Antonio, Te Vehicle Emissions Research Lab., NAPCA Contract PH 22-68-36, SwRI Rept. AR-718, 166p., Feb. 1970. 8 refs. CFSTI: PB 191529

A workable method of sampling public opinion of diesel exhaust odor was conceived and employed. The method involved use of a calibrated mobile odor evaluation laboratory similar to the odor room used by the trained odor panel at SwRI. Opinions on a series of three levels of diesel odor were obtained from 3039 persons whose backgrounds, ages, and places of residence are well distributed with respect to the total urban population. A majority of all the participants rated more intense diesel exhaust odors higher on the cartoon-objectionability scale than less intense odors. Approximately 75% of the participants selected a higher cartoon number for test 2('D-4') than for test 1('D-2') and about 86% of them found test 3('D-6') more objectionable than test (1'D-2'). This determination is based on results obtained from 3039 people in five major U. S. cities. Some variation in odor response from city to city can be found which remains unexplained by consideration of variation in socioeconomic characteristcs of the several populations or other quantitative factors. In particular, San Antonio participants seemed to find the exhaust odors less objectionable and Los Angeles participants seemed to find them more objectionable than did the Chicago, St. Louis, and Philadelphia participants, whose responses were close to the average. Participants and passers-by in Los Angeles were very quick to associate the survey with air pollution, but those in San Antonio had little to say about pollution, and, again, the participants in the other three cities fell between the extremes. San Antonio has the cleanest air of the cities surveyed, and Los Angeles is at least the best known of the five cities for polluted air if it is not in fact most heavily polluted. It is quite possible that a relationship exists between response to diesel exhaust odors (or, for that matter, almost any pollution-related subject) and public awareness of and attitudes toward air pollution both of which depend on the severity of the local pollution problem and the type and amount of publicity given it. This study did not make an accurate determination of public attitudes and knowledge about air pollution, but the strength and frequency of the aforementioned unsolicited comments made to the survey crew give a qualitative indication of public concern. The indication is that high local pollution and/or high awareness of it are associated with more objectionable characterization of odors, and vice versa. Highly concerned citizens might rate the odors they perceive as being slightly more objectionable than they actually are in the hope that they can thereby strike a blow at pollution in general.

24091

MacLaren, James W.

ENGINEERING THE METROPOLITAN ENVIRONMENT. Eng. J. (Montreal), 53(6):16-25, June 1970. 10 refs. (Presented at the Engineering Institute of Canada, Annual Meeting, Vancouver, B. C., Sept. 10-12, 1969, Paper EIC-70-CIV 4.)

It is important to recognize the benefits that can accrue to the urban environment in the adoption of regional government and to be aware of the restrictions that can still obtain in engineering the optimum system. It should be recognized that in regard to water supply, solid waste disposal, waste water control and air pollution control, the regional concept is developed not for local servicing but to establish framework schemes. Every regional activity must be developed in the best interest of the area but with a full awareness of its effects on other activities. Too often, political and single purpose thinking establishes the regional system and its development plan and the 'best fit' comprehensive approach is bypassed. It has been demonstrated that engineering the regional or metropolitan environment requires some difference in appreciation than might be necessary in typical municipal design. It is essential that this difference be appreciated in relation to sepcific experience to date. The implications of regional development in terms of water supply, waste water control, solid waste disposal, air pollution control, financing, and legislation are elaborated. A comprehensive study of the air pollution situation should result in an air resource management program including air quality monitoring, emission inventory, air quality standards based on criteria, and a thorough knowledge of the local conditions influencing the transport of pollutants. Implementation of the air use plan should include regulations to reduce odors, particulates, sulfur dioxide, hydrocarbons, carbon monoxide, oxidants, and nitrogen oxides. A metropolitan effort is necessary to successfully achieve these goals.

24768

NATIONAL SURVEY OF THE ODOR PROBLEM. PHASE I OF A STUDY OF THE SOCIAL AND ECONOMIC IMPACT OF ODORS: APPENDIX. Copley International Corp., Contract NAPCA 22-69-50, 342p., Jan. 1970. NTIS: PB 194377

Fourteen appendices are compiled in support of Phase I of the National Survey of the Odor Problem. They include a list of the major odor-producing air pollutants with olfactory thresholds and related data, the questionnaire used in the survey, locations of the survey areas, and tabulated summaries of survey findings. For all survey cities combined, opinions of residents are summarized, respectively, by income, occupation, age, and education. Summaries are also presented of the opinions of residents of the individual cities and of the combined opinion of businessmen in all cities surveyed. For survey plan and analysis of results, see NTIS: PB 194376.

26725

Peckham, Brian W.

SOME ASPECTS OF AIR POLLUTION: ODORS, VISIBILITY, AND ART. Preprint, Water Resources Research Center, 13p., 1969. (Presented at the Seminar, on Economics of Air and Water Pollution, Seminar, Blacksburg, Va., April 28-30, 1969.)

The interference of air pollution with man's esthetic and psychological needs are discussed and numerous examples given. Odors, though frequently confined to a small area, can sometimes span considerable distances and can damage health and deprive people of the use and enjoyment of their property at all economic levels, as confirmed by surveying court records. Methods and problems of odor measurement and evaluation are reviewed. Air pollutants also offend the sense of sight; aerosols affect visibility both by scattering and absorbing light, often aggravating fogs and diminishing sunlight and creating difficult and hazardous travel conditions. Another kind of injury to esthetic sensitivies occurs when air pollutants, primarily sulfur oxides, accelerate the decay of sculpture and architecture, damage artwork even in indoor environments, and increase the deterioration of library holdings. Other miscellaneous effects which impair the quality of urban life include damage to city plantings, adverse effects on athletic performances, and increased population movements out of cities. Society must decide how to resolve conflicting technical and biological/amenity claims on natural resources so that the general welfare shall be at a maximum.

27680

Hoshoka, Yasuyuki, Shinofu Niki, Tomohiko Ishiguro, Yoshiyuki Katori, and Yoshihiro Shigeta

IMPORTANCE OF OPINION SURVEY USING QUESTIONNAIRES IN ODOR POLLUTION SURVEY. REPORT NO. 3 ON STUDIES OF ODOR). (Akushu kogai chosa ni okeru anketo kikitori chosa no juyosei (Shuki no kenkyu dai 3 po). Text in Japanese. Preprint, p. 38-39, 1971. (Presented at the Disaster Prevention Chemistry Meeting, Japan, 11th, Jan. 1971, Paper 20.)

The approach of the Environmental Hygiene Center in conducting a questionnaire type of survey was to divide the area around a factory which was emitting an odor into 8-10 sections, then visit 30-40 houesholds in each section, preferably in the evening so that it would not only be the housewives who answered the questions. At the same time, a direct survey was made of the source of odor and the environment. Question No. 1 sought to determine the area of the odor and its degree, while an answer to the second question would indicate whether the factory had adopted odor counteraction methods. Several questions sought to determine who among the family members was most affected and for long, while the answer to the seventh question would indicate how meteorological conditions have affected the odor. A rendering factory and 133 people from 0.5 to 1.7 km downwind of it were chosen for the survey. Complaints ranged from 'unpleasantness' to 'no appetite'. The odor was strongest in the rainy season, from noon to evening, on cloudy days, with a west wind; wind velocity was not too high. An area in the vicinity of a pharmaceutical company was similarly investigated, and methylmercaptan and dimethylsulfide were detected chromatographically.

30896

Miyoshi, H., A. Fukuda, and T. Mizuki

EPIDEMIOLOGICAL CASE STUDY ON COMPLAINTS OF ODOR. (Akushu kujo jirei no ekigakuteki kenkyu). Text in Japanese. Taiki Osen Kenkyu (J. Japan Soc. Air Pollution), 5(1):143, 1970. (Proceedings of the Japan Society of Air Pollution, Annual Meeting, 11th, Tokyo, Japan, 1970.)

Questionnaires were sent out to the citizens of Tokuyama City, Yamaguchi Prefecture, in July 1967 and November 1969 as a result of an average of 150 complaints a year against the odor created by the city s petroleum chemical industrial complex. Investigations by monitors and reports on complaints were studied in detail. A total of 42 complaints were reported in January to June in 1969; 112, from July to December 1969; and 63, from January to June in 1970. In each case, time, geographical conditions, descriptions of odor and physical effects, wind velocity, and the emission sources were investigated. Studies were sent to the management of the industry. Requests were made to avoid repetitious offenses, maintenance of repairs, and prevention of gas leakage, and for a better understanding and recognition of air pollution among the factory workers. The city of Tokuyama is offering the results of these investigations as basic data for industrial complex administration and for gas analyses in the future.

31071

Greene, Charles H.

INDUSTRIAL MANAGERS SPEAK OUT IN POLLUTION SURVEY. In: Pollution Control Update, Spec. Rept. by Mod. Mfg., 2p., 1970.

The results are presented of a survey of manufacturing managers in 10 major industries on plant emissions, the standards governing them, abatement practices, and their personal commitment to a cleaner environment. Over 75% of the managers surveyed were personally familiar with existing standards. Despite strong personal desires, about 40% of the plants currently do not meet the air pollution standards that apply to them. Particulates are the biggest problem, with sulfur dioxide and odors following. Control equipment includes wet scrubbers, fabric filters, mechanical collectors, and a wide variety of other types. Budgeting for pollution expenses in an area in which problems are anticipated; most of the respondents do not have a separate budget for their anti-pollution operations.

N. GENERAL

01539

J.H. Broomhall

THE PUBLIC HEALTH INSPECTOR'S ROLE IN AIR POLLUTION CONTROL. Can. J. Public Health (Toronto) 57(2):87-88, Feb. 1966.

The role of the public health inspector in policing air pollution in Alberta, Canada is discussed. Services performed include investigating complaints, and observing, recording, and conducting surveys of new sources of pollution. The results of two surveys of odor in residential areas are given.

03438

B. C. Blakeney and M. D. High.

CLEANER AIR FOR NORTH CAROLINA (A SURVEY AND APPRAISAL FOR AIR POLLUTION PROBLEMS). North Carolina State Board of Health, Raleigh, Div. of Sanitary Engineering and Public Health Service, Washington, D.C. Div of Air Pollution. Sept. 1959. 62 pp.

The most frequently occurring air pollution problems attributed to industrial and municipal establishments results from emissions of smoke, soot, or fly ash from fuel burning equipment. The lumber, wood and furniture industries are frequently sources of dust. Asphalt paving material plants create more acute air pollution problems than any other industry. Pulp and paper mills are the cause of odor complaints and are considered the cause of some property damage. A variety of waste disposal operations emit excessive smoke and odors. In eight cities, open dumps have caused complaints and in five cities semi-landfills (burning before covering) have resulted in public request for relief. Control of gases, dusts, and other pollutants cannot be legally required by the State except through the Nuisance Code or indirectly through some other statue. The lack of specific State legislation limits the control of air pollution to the jurisdictional area of a few cities, whereas pollution of community air is not confined to man-made boundaries or jurisdiction. Existing and potential air pollution problems requiring further investigation are discussed.

05235

Mazitova, R. M., V. N. Okhotskaya, and B. I. Puchkin

OLFACTORY SENSE AND ITS SIMULATION BY MODELING. Text in Russian. In: Olfactory Sense and Its Modeling. ((Obonyaniye i yego modelirovaniye.n8) Siberian Affiliate, Novosibirsk, 'Nauka' Publishing House, 1965, Chapt. V, p. 106-114, 6 refs. Engl. transl: JPRS (38,994,12 p., Dec. 7, 1966.)

The authors discuss present-day functional methods of the peripheral part of the olfactory organ. These models correspond to the original and are more accessible to study then the olfactory analyzer. The usefulness of the models discussed is determined not by their absolute correctness or correspondence to the olfactory analyzer, but by whether they can offer a more rational approach to the investigation of olfaction, or help in the elicitation of the true nature of olfaction. A model may provide the basis for the study of many aspects of olfaction. The adsorption theories served as the basis for the majority of known models of the olfactory analyzer. Illustrations of the Dravnieks, Moncrieff, and a simplified model are included. The so-called 'electric rose' created by Rosano and Skeps and the 'electronic blood hound' are discussed. Models of the olfactory analyzer may find widespread use in the chemical, food and perfume industries, medical diagnosis, the deodorization of conditioned air, the localization of leakage in gas-pipe systems, etc. It is also pointed out that recent research in this field makes it possible to evaluate objectively the quality and intensity of various odors, and even obtain some idea as to the nature of odors, although the mechanism of perception of odor has not been definitely clarified as yet.

19060

Lukacs, J. and A. T. Rossano

AIR POLLUTION AND ITS CONTROL. J. Can. Petrol. Technol. (Montreal), 6(1):23-26, Jan.-March 1967. 5 refs. (Presented at The Petroleum Society of CIM Annual Technical Meeting, 17th, Edmonton, May 1966.)

The sources, effects, and meteorological conditions of air pollution are discussed. There are many sources of pollution, including natural and man-made ones. The man-made sources, such as combustion, steel mills, refineries, pulp and paper manufacturing, and food processing generally outweigh the natural sources in number and importance. Man emits dusts, fumes, smoke, soot, flyash, sprays, and mists to the atmosphere in large quantities. The severity of air pollution in a given area is determined largely by the meteorological conditions. The most undesireable meteorological condition is an inversion layer. Inversions lead to poor dilution and dispersion of plumes, and pollutants tend to concentrate in the atmosphere. The effects of pollution vary widely: smoke can reduce visibility; hydrogen sulfide and mercaptans have very objectionable odors; soiling and corrosion of materials result; and plants and animals may be severely injured or killed. There is medical evidence that air pollution is related to emphysema, chronic bronchitis, and lung cancer. It is recommended that new methods be developed to produce by-products from potential contaminants, rather than building higher stacks. Consideration is given to air pollution in Alberta, and an air quality control program is proposed.

19088

Thuman, William C.

ACTIVITIES OF THE NASA-SPONSORED SRI TECHNOLOGY APPLICATIONS TEAM IN TRANSFERRING AEROSPACE TECHNOLOGY TO THE PUBLIC SECTOR. (QUARTERLY PROGRESS REPORT). Stanford Research Inst., Menlo Park Calif., Contract NASw-1992, SRI Proj. PAU-8368, Rept. 1, 37p., Oct. 1969. CFSTI: N70-18913

An interdisciplinary Technology Applications Team was established to plan, coordinate, control, and evaluate a program to apply aerospace data to the solution of public sector user problems in the fields of criminalistics, transportation, and air pollution. Emphasis is placed on users west of the Rocky Mountains. Problems are identified through visits to and consultation with user agencies. Two air pollution control agencies, the Bay Area Air Pollution Control District and the Air and Industrial Hygiene Laboratory of the California Dept. of Public Health, were visited. The major problem identified was the requirement for relatively inexpensive continuous monitoring instruments for the measurement of opacity and the identification of particle size and composition in photochemical smog, concentration and composition of gaseous emissions, wind speed, temperature, and direction, and odors. Other problems mentioned were the need for a method to remove sub-micron particles from stack effluent and several biomedical problems associated with air pollution.

20495

Research Triangle Inst., Research Triangle Park, N. C., Engineering and Environmental Sciences Div.

APPLICATIONS OF AEROSPACE TECHNOLOGY IN AIR POLLUTION CONTROL. (FINAL REPORT). NASA Contract NSR-34-004-056, RTI UE-411-3, 65p., June 1969. CFSTI: N69-36186

The Technology Application Team of the Research Triangle Institute, Research Triangle Park, N. C. acts as an information and technology interface between the National Aeronautics and Space Administration and National Air Pollution Control Administration and as a catalyst among the various sources of information involved in the technology. It identifies very specific technology-related problems and prepares air pollution problem abstracts on each specific requirement which describes the problems in a concise manner using functional nondisciplinary terminology. The specifically described problems include automobile drivers performance tests; remote temperature and wind vector sensing techniques for the lower 2 km of the atmosphere; long-term geophysical effects of carbon dioxide and of particles in the 0.2 to 0.5 micron size range; development of advanced pollutant sensors for methane, sulfur dioxide, fluorine, carbon dioxide, total hydrocarbons, carbon monoxide, nitric oxide, nitrogen dioxide, and total oxides of N2; improvement of adsorption and absorption techniques for removing pollutants from carrier gas streams; instrumentation for the investigation of flame chemistry; effect of trace qualitites of metals and impurities on pollutant identity and output in combustion; analytical techniques for the trace metals in combustion effluent and waste gases from metal processing, both in collected particles and in situ; fluidized bed combustion processes; working fluids for Rankine cycle engines; heat transfer to small gas-borne particles; physical consideration in optimizing fuel-air mixture; measuring techniques for air-borne particulates; and gas exchange capacity of lungs. Other problems mentioned, but not specifically described are oder classification and identification; development of advanced pollutant sensors for As, Be, Hg, Ni, NH3, carcinogens, Cl and HCl, H2S, V, ozone, Br, Ce, F, I, Pb, reactive hydrocarbons, and Cd; holographic techniques for measuring particulate flux, and combustion chamber aerodynamics.

32254

Nordrhein-Westfalen Arbeits-und Sozialminister (West Germany)

THE SITUATION IN NORDRHEIN-WESTFALEN IN 1970 AND DEVELOPMENTAL TRENDS. (Situation in Nordrhein-Westfalen 1970 und die Entwicklungstendenzen). Text in German. In: Reinhaltung der Luft in Nordrhein Westfalen, Essen, West Germany, Brinck and Co. KG, 1969, p. 75-83.

The population density of the industrial regions of the state is 1300 to 3000 inhabitants per sq km. These regions are the home of 90% of all coal mines, 70% of the steel industry, 50% of the heavy chemical industry, and 35% of the refineries in all of West Germany. To the emissions from these industries must be added those from 5.5 million households and from 3.5 million automobiles. Since the introduction of mandatory certification of polluters, air pollution in the entire area has decreased markedly. The projection for SO2 emission in West Germany is that it will increase by about 25% until 1975 and from then on will decrease because of the construction of nuclear power plants. In the U. S., in contrast, SO2 pollution will double until 1980 because of widespread use of coal. Pollution trends will be further affected by the growth rate of the chemical industry, which will expand from an index of 100 in 1962 to an index of 320 in 1975. The importance of SO2 as a pollutant will diminish to be replaced by fluorine, hydrocarbons, chlorine, and odorous emissions. The emission of fine dust as a health hazard will increase and dust fall measurements will have to be supplemented by dust concentration measurements. The problem in the steel industry will be fine dust control; in the aluminum industry, fluorine emission control; in steam power plants, fine dust control; and in domestic heating, nitrogen oxide control. Pollution from automobiles is expected to increase until 1975, especially from nitrogen oxides.

AUTHOR INDEX

A

AARONSON A E *A-34766
ACRES G J K *B-27154, *B-31400
ADALBERTO T A *B-33073
ADALBERTO, T A C-09660
ADAMS D F *B-32681, C-18194
ADAMS, D F A-00525, B-00379, *C-05426, *C-06526, *C-08268, *C-09619, *F-01784, F-10308
ADAMS, D. F. *B-04773
ADOLF H R B-32166
ADRIAN, R C B-06088
AGNEW W G *B-17906
AIKENS A *B-28206
AINSLEY Y *A-28352
AINSWORTH L D B-22837
AKAMATSU I *A-16494
AKAMATSU K *B-22061
AKAMATSU, I *B-13072
ALBERTE T *A-27986
ALFEROVA L A *B-29278
ALKIRE H L A-11700, *A-12832, *A-12834, *A-23313, *A-23314, *D-23411
ALPERT S *G-23298
AMBERG H R B-16842, B-17409
AMOORE J E *C-17044, *C-32268, *F-19061
ANDERSON C E *B-32166
ANDERSON D M *D-31760
ANDERSON L W *B-29261
ANDERSON, F J *B-06363
ANDO T B-14488
ANDREESHCHEVA, N G *G-11476
ANGLERAUD, O *G-00715
AOKI T *B-31160
AOYAMA M *B-32847
APPELL L *C-26096
ARAKI T *C-34279
ARCHIBALD E E JR *B-25950
ARGIROWA M K-30870
ARHIPPAINEN, B *B-09933
ARITO, H C-10983
ARTHOR D LITTLE INC *C-11123
ASAKURA N A-28614
ASHIDA K B-32799
ATARASHI Y *A-26575
ATSUMI M *C-16134
AVERY R H *B-29323
AVY, A P *B-03129
AZUMA T M-13980

B

BABA Y *B-26128, *C-17288, *C-27475, *C-29726, *C-31924
BACHMAIR A *B-33854
BACHMAN, H E B-11220, B-11234
BAIKOV B K *D-16636
BALAKRISHMAN S *A-32385
BALESTRIERI, S C-01289
BANDUNI, J S B-04045
BANNER, A P *B-02725
BARNARD N J C-14109
BARNEBEY, H L *B-04943
BARNES G J *A-20118, A-33564, C-22448
BARTH C L *C-35865
BARYNIN J *C-24071
BASE J C-29243
BASMADSHIJEWA K *K-30870
BAUCH H *B-21294
BAUM F *B-23885
BAUM, F *A-08373
BAUMGARDNER R C-34863
BEARD, C G II A-02765
BECK H G-34686
BEHRENS M D B-27401
BEI[illegible]E H A-25179
BE[illegible]SER, F R B-04227
BE[illegible]KY T C-29858
BENDL H *B-31302
BENFORADO D M *B-13971
BENFORADO, D *B-11136
BENFORADO, D M B-00257, *B-06366, *B-08506, *D-07572
BENGER M *B-26908
BENJAMIN, M *A-12621
BERDICK M C-35648
BERMINGHAM P E *L-34033
BERNERT J *B-21888
BERNHART A P *A-34018
BERNICCHI R V *B-18153
BETHGE, P O *C-07214
BETZ, E *B-04300
BILLER W F A-35635
BILLER, W F D-00251
BINDER H *C-14197
BISTOWISH J M *L-19059
BISWAS B K *B-26731
BLAKENEY, B C *N-03438
BLOKKER P C *A-31882
BLOSSER, R O *B-07415, *B-10277
BLUE J D *B-31463
BLYTHE D J *A-26402
BODURTHA F T B-27605
BOEGLY W J JR *A-32411
BOGEN N *D-33539
BOLDUE, M J *B-03966
BOLZE C A-24459
BORRELLI, F G-00715
BOWERS P H A-31323
BRADT, P D-00690
BRAMBLETT J D-23411
BRANDENBURT J T B-27401
BRETSCHER H *B-16712, *B-23371
BREWER, G L B-03966, *B-11137
BRIEF R S D-31760
BRIGANTI A *B-23319
BRINK D L B-11673, B-12506, *B-20258, F-16828
BRINK, D L *A-06981, A-08359, *C-08354

BROADDUS, S B-07434
BROCKE W A-25179, B-23885
BROERING, L C C-00178, C-08678
BROOMAN, D L *B-00286
BROOMHALL, J H *N-01539
BUCHBERG, H *G-00177
BUCOVE, B D-06535
BURCHARD H B-21294
BURGESS R E F-32271
BURNETT W E *B-19182, *C-13749
BURNHOUSE, W A *B-09922
BURT L R *B-21006
BUXTON W H JR *B-31790
BUXTON, W H *B-04783
BYRD J F *C-32676
BYRD, J F *B-02729, C-05898

C

CADY, F H *B-00552
CAREY, A W A-05335
CARLSON D A *B-27336
CARLSON, D A B-01563
CARLSSON B O *A-30389
CARRUTHERS J D *B-34679
CARVER, T O *D-06535
CAVE, G C *C-08355, *C-08356, *C-08357, *C-08358
CEDERLOF, R *C-00965, *C-09648, *D-00209, *G-00208
CESTA R P K-21918
CHANSKY S H *A-22860
CHASS, R L C-03010
CHATFIELD, H E *B-09819
CHISHOLM J A C-13367
CHOLARK J *D-23845
CHURCHILL J D-31760
CHZHEN TSI C *K-20194
CLAPHAM T M *B-31211
CLARK W E A-32411
CLAYTON P *B-32302
CLEARY G J *C-16754, *C-25065
CLEMENT J L *B-16747
CLEMENT, J L *B-12658
COLLINS T T JR *B-15779, *B-26172
COLLINS, T T JR *B-04781
COLUCCI J M *C-22448
COLVER W C-20192
CONNELL, G F B-06688
CONRADI K A-21700
COOPER H B H JR *C-35956
COOPER, B H JR B-07415
COOPER, G D-07572
COOPER, H B JR B-10277
COURAU P J *B-30809
CROSS F L JR *L-15554
CUFFE, S T B-07875
CUOMO A J G-27137

D

D IMPERIO, J *B-09815
D'IMPERIO, J *B-09857
DAMON W A *B-24743
DANIELSON, J A B-06412, *B-09784
DAVIS J C *B-30062
DAVIS J R D-31760
DAVIS R F A-35590
DAWIDKOWA E K-30870
DENDA T B-14488
DENMEAD, C F *C-05503
DESIDERATI P *B-25623
DEVORKIN, H *C-03010
DEWITT I L A-29698
DEY, H F *B-09791, B-09852
DIMITRIOU A N A-22860

DOBASHI S C-30689
DOMON T A-21857, C-17638, *C-21866
DON W A *K-31286
DONALDSON W R *A-32653
DONDERO N C B-19182
DONKELAAR VAN A *D-16062
DORSTEWITZ U A-33719
DOUGLAS, I B *A-04893, B-04950
DOUGLASS I B *A-28885
DOUGLASS, I B *A-01644, *A-04879, *A-11144, A-12621, *B-04861
DOVING K B *C-32269
DRAVNIEKS A A-25327, A-34964, C-10693, C-13969, *C-35541
DRAVNIEKS, A *C-09521, *C-09620, *C-10016, *C-10593
DRINKER P A JR D-31760
DROWLEY W B *L-25446
DUBOIS W H B-28047
DUCKWORTH, S *A-03097
DUERDEN, C *B-01352
DUFFEE R A B-20824
DUFFEE, R A *C-06381
DUNCAN L *B-34868
DUPREY R L L-12511, L-16330

E

ECKERT, J S *B-04949
EDFORS, M L C-00965, D-00209
EDGERLEY, E JR B-00286
EDWARDS F R *B-30943
EDWARDS T H *F-14987
EGLIT M E *G-35671
EGUCHI Y *B-17314, *B-31354
EHRENBORG, L C-07214
EKBERG, G B-06280
EKMAN G *C-21652
ELFIMOVA, E V *G-05942
ELLIOT J S B-16747
ELLIOT M A *A-35590
ELLIOT T C *B-29877
ELLIOTT L F *A-35564
ELLIOTT T B-31062
ELLIOTT, J S B-12658
ELLIS W H *B-16890
ELNICKI W *B-24197
EMANUEL, A G *B-03972
ENDO R *A-17198, *A-17631, D-17630
ENDO T *B-26308
ENGDAHL R B *A-34228, B-14967, B-33077
ENGSTROM S *A-30327
ERDMAN, T C C-10534
ESSENHIGH R H *A-28861, *B-26730, B-26731, B-35566
ETTINGER, M B A-07089
EVERS R L A-21978
EWING, R C *A-12083

F

FABUSS B M *B-28047
FAITH W L *B-13551, *B-32682
FAITH, W L *B-03297
FATTINGER V *B-29363
FAWCETT R L *B-19493
FEIST, H J *B-07362
FEITZELMAYER K *A-21700
FEL DMAN, Y G *K-05947
FELDSTEIN, M *C-01289
FERBER M *A-11969
FERNANDES J H *B-22357
FEROGLIA, W E G-06323
FERRARI, L M B-01414
FEUERSTEIN, D L *A-08359, C-08354
FIALA E *C-16298
FIALA, E *B-07224, *B-08604
FIELD E L A-22860
FIELD J H *A-33188
FIELD S C-20192
FIELD, S N C-10534
FIFE, J A *B-10009
FIRST M W *C-25054
FIRST, M W *A-09175, *B-02047
FONES R E *B-13398
FONTIJN, A *F-07681
FOSBURG S D-33539
FRANZKE H H *A-21882
FRANZKY U *A-21887, *A-24754, *B-14004, *B-16113, *C-20538
FRANZKY, U *B-11059
FREY A H *C-23755, *G-20969
FREYSHUT S *B-17266
FRIBERG, L C-00965, C-09648, D-00209, G-00208
FRICK, R *L-09215
FRISCH N W B-20817
FUDURICH, A P C-03010
FUJII S *B-14951, *C-21208
FUJII T *A-17634
FUJITA I B-23002
FUJIWARA M A-16135
FUKUDA A M-30896
FUKUDA S C-17639
FUKUI H A-26826
FUNAKI H A-17633

G

GABRIEL K L C-20192
GAINER J G *L-32352
GALEANO, S F *D-12648
GANDHI K B-21938
GARDNER, J W *L-03198
GAYNULLINA E T *C-35182
GEHM, H W *L-06732
GELLMAN I B-34868
GERHARDSON G *K-18294
GERSTLE R W L-33672
GESTELAND R C *G-21359
GHISONI P *B-26176
GIEVER P M *A-32489
GIEVER, P M *C-09476
GIL DENSKJOL D R S *D-16635
GILGEN, A *G-07821
GILLS, B *A-02001
GILLS, B G *B-04361
GILMORE F R A-33828
GLAZE W H C-13143
GOLDBECK, R A *G-06323
GOLDBERG A S *B-32935
GOLDENBERG D M G-21712
GOLDFIELD J *B-21938
GOLDHAFT T M A-35673
GOMMI J V *B-24079, *B-32937
GONDIM P M *A-32465
GOODWIN J T JR A-24459
GORMEL B B-35879
GRAMES, L D B-00257
GRAY A W *L-35694
GRECO V B-21938
GREEN W *B-31062
GREENE C H *J-34518, *M-31071
GRENNFELT P *C-35949
GRIDGEMAN N T *C-34178
GRIFFITH W L A-32411
GRILLOT R *B-13812
GRIMLEY K W JR C-19051
GROSS L J B-15709
GRUBER, C W A-05608, C-00178, C-08678
GRUTSCH J F B-22435
GTOWIAK, R B-10588
GUEST E T *B-13772, *B-26173
GUEVARA, M V B-04045
GUILLOT M *F-24531
GUMERMAN, R C *B-01563
GUTHMANN, K *L-01528

H

HAEDIKE E W *A-34654
HALES J M *E-22335
HALES, J M B-00025
HALITSKY, J A-07561
HALL L B D-31760
HAMANABE Y *A-21857
HAMAUZU Y *C-17290, C-21866
HAMMOND, W F B-06088
HANSEN, G A A-12621, *B-08360
HANSTEDT, W *A-11651
HARDING, C I *B-01505, B-01900, B-02018, *B-09508
HARDISON L C *B-23967
HARE C T B-23067, M-23408
HARIMA H C-17638
HARIMA S A-21857, C-21866
HARRIS E K D-31760
HARRIS M M D-31760
HARRIS, E R *B-04227
HARRIS, E S *A-03825
HARRIS, T O D-02331
HART S A B-22550
HARTLER, N *B-08361
HASEBE N B-14203
HASHIMOTO K *B-17403
HASHIMOTO M *A-16135
HASSELHUHN, B *C-09657
HATTORI S D-26304
HATTORI T *L-32893
HAWKINS G *B-18140
HAYASHI M *A-30687
HAYASHI S A-30687
HAYASHINO M C-17640
HAZEN T E C-13099
HEANEY F L *B-31453
HECKEL U A-33713
HEDLUND, F *B-06280
HEIN G M *B-14967, *B-33077
HELLER A *B-22525
HELLER, A N D-00751, D-06535
HEMEON W C L *A-35638, *L-32566
HEMEON, W C L *C-09364
HENDERSON W L *B-25554
HENDRICKSON, E R *B-01900, *B-02018
HENLEY D E *C-13143
HENSCHLER D *G-34686
HENSHAW, T B *B-00571
HENZ D J *L-33672
HESCHELES C A *B-30773
HETTCHE, H O *B-07374, *B-07530, *B-07531
HEUSER A R *B-16498
HICKS R *A-25228
HIGGINSON A E *A-29353
HIGH M D *B-32646
HIGH, M D N-03438
HILBIG V A-33713
HILDEBRAND, P W *D-01949
HILLIGER H G *A-33713
HIND C J *A-14297, *A-30603
HIRABAYASHI M B-27541
HIRAIKE M *A-29332
HIRAKAWA H A-17631
HIRAMA M *B-32799
HIRAYAMA H C-17639
HIRD S A *F-23187
HIROBE H D-20355
HISHIDA K A-32855

HOCHHEISER S A-27451
HOCHHEISER, S A-05549
HOCHMUTH, F W *B-11153
HOCHSTETTLER A D C-18093
HODGSON F N A-21978
HOEFFKEN F *L-22343
HOFFER R F D-23845
HOFFMANN, H *A-08802, *B-08497
HONDA A *B-33122, I-19325
HONDA K *B-31091
HONMA T B-26296
HOPPER W C *B-27719
HORNSTEIN I *F-19063
HORRES C R JR C-19051
HORSTMAN, S W *D-00751
HORTON D L B-13971
HORTON R J M *A-00402
HOSHIKA Y A-20706, *A-28527, *A-31044, *A-31263, *A-32879, *B-26014, C-20264, *C-22431, *C-29508, *C-30374, *C-32880, *D-23098, *M-27680
HOUGH G W *B-15709
HOWE, E L A-02001, B-04361
HOWORTH F H *B-35955
HOWRIGAN G D-33539
HRUTFIORD B F A-33983
HRUTFIORD, B F A-01885, B-04950, B-04952, B-04953, *B-05409, F-12662
HSUEH L B-26254
HUCH R *A-25179
HUEY, N A *C-00178, *C-08678, *L-10484

HURN R W A-12505, *A-14116, A-14914, *A-27249, *B-30865, *C-20100
HURN, R W *D-00241

I

ICHIKAWA M *B-32119
IIDA S *B-14203
IKEDA H B-17635
IKEHATA A *B-16535
ILGENFRITZ, E M B-02725
IMADA M C-29858
IMAI K F-13107
IMAI T *B-31233
INGRUBER, O V G-03788
INOUE T *B-27674
ISHIGURO T A-20706, *A-22987, *A-23000, A-28527, *A-32855, B-17636, B-20628, B-24380, *B-26002, B-26014, *B-32797, C-17628, C-20264, *C-27685, C-28787, *C-30689, *L-33117, *L-35752, M-27680
ISHIGURU T C-30689
ISHII K *A-25056, *A-26574
ISHII T *B-32798
ISHIKAWA K *B-17395, K-35146
ISHIKAWA M F-26529
ISHIKAWA Y D-26304
ISHIZAWA M M-13980
ITAYA J C-31222
ITO H I-19325
ITO K C-16134, F-19102
ITO N *B-34073
IZMEROV N F *K-21084

J

JACOBS, M B A-07561
JAHNKE H *B-25711
JENKINS, H N *D-02331
JENSEN R M *A-22973
JENSEN, D A *B-00504
JENSEN, G A *B-00379
JOHANSON, L N B-04952, B-04953, B-05408
JOHNSTON J W JR F-19061
JONES K H *B-11673, *B-12506, B-20258, F-16828
JONES, K H A-06981
JONES, M H G-00177
JONSSON S E *B-30339
JONSSON, E G-00208
JULSON J O *J-16457
JUNKER T J B-31211
JUST, J *C-09716
JUTZE, G A C-08678
JUTZI W *C-15677

K

KAEDING, J H G-06323
KAFKA, F L B-01414
KAINOSHO M *C-12487
KAISER E R *C-26966
KAISER, E R *A-07561
KAIU, L G-00208
KAKUDA C C-28787
KALISH J *B-34385
KAMETANI, F A-06240
KAMISHIMA H A-16494
KAMISHIMA, H B-13072
KAMITSU K A-17462
KAMO, R A-05335
KANAMARU T D-20355
KANAZAWA K C-17638
KANNO K *A-21661
KANTER, C V C-03010
KAPLAN L M *A-27821
KASPARICK, M F *B-00032
KATAGIRI T *B-30479
KATAYOSE S *B-27548
KATO S B-28756
KATO T *C-12488, *C-17629, *C-31222, C-32467, *C-32795
KATOH T *C-28787
KATORI Y M-27680
KATZ, M D-00690
KAWAGUCHI T C-17629
KAWAI S A-26826
KAWASHIMA T A-17462
KAY R E *C-34972
KAYLOR, F B *L-04942
KAZUMI J B 20628
KEAGY, D M *L-00549
KELLUM J *B-23594
KEMNITZ, D A B-07875
KENDALL D A C-14109, C-27934
KENDALL, D A *A-04785
KENJO, T I-05463
KENLiNE, P A *B-00025, *D-03017, *D-03459, *D-03506
KERSHENBAUM, L C-10534
KESHEN A S *A-35383
KIFUNE I C-21859
KIKUCHI I A-17632, *A-17633
KIKUCHI K *B-22538, *B-26567, *C-23106
KIMURA Y A-16494
KING P J F-16696
KINOSIAN, J R K-00157
KINSEY, R H *B-09839, *B-09840
KITAGAWA Y D-23149
KITAMURA H F-13107, F-19102
KITTREDGE G D A-30851, B-20120
KITTREDGE, G D B-09608
KIYOZUMI H C-16134
KLEIN N *B-35554
KLEPPE P J *B-32615
KLINCK R W B-27357
KLINE M F *B-20754
KNIEBES D V *C-13367
KOBAYASHI A C-30689
KOBAYASHI I C-30689
KOBAYASHI S C-17640
KOBAYSSHI Y *A-30513
KOGO T A-17631, *D-17630
KOIZUMI M A-25056
KOMORI K F-26529
KONDO K *I-19325
KOPPE, R K F-01784, *F-10308
KORTH M W *B-12133
KOSAKI M *B-31223
KOSAYA G S *B-31072
KOYAMA I B-24380
KOYAMA K B-20628
KOYAMA O B-17636, C-17628
KOYAMA Y B-14488, *B-33003, *B-33380, C-17640
KRAHL H *B-31167
KRANE D *B-14453
KRANIG L E *B-28118
KREICHELT, T E *B-07875, L-02840
KROTOSZYNSKI B K *C-10693, *C-13969

KROTOSZYNSKI, B C-09620
KROTOSZYNSKI, B K C-09521, C-10016, C-10593
KUKIN, I *B-07971
KUMAGAI Y B-16535
KUO T A-28861, B-26731
KUO T J B-26730
KURMEIER H *B-30350
KURMEIER H H *B-14671
KUWATA S C-17641, C-21858, C-30811
KUZUMA J *B-24380

L

LADAM A B-13812
LAFFORT P *C-29269
LAMANTIA C R A-22860
LANDEN E W A-20101
LANDRY, J E B-01505, *B-02279, *B-08364
LANG D A C-35648
LANG O *C-28393
LANGMANN, R *L-07235
LANGNER H J A-33713
LAPOINTE, M W B-04783
LARDIERI N J *B-35660
LARSEN R I D-31760
LARUE P G *B-23836
LAWTHER, P J A-09255
LEAK R J *B-27401
LEBLANC F *H-20028
LEDBETTER, J O *B-01508
LEE S D G-23298
LEISER C P B-27336
LEITHE W *C-30014
LENZ, W *B-03946, *C-09660
LEONARD, J S *C-03789
LEONARDOS G *C-14109, *C-27934
LEPISTO, P B-01867
LESNIK G E *E-14906
LESNINI D G B-16890
LEVAGGI, D A C-01289
LEWIS T R G-23298
LI PUMA T B-32646
LIEBERMAN, A *B-05532
LIEDMEIER G P *L-14798
LIENESCH J H *A-20125
LINDBERG E A S *B-25085
LINDBERG, S *B-01549, *B-09656, *B-09661
LINDH, K G G-00177

LINDVALL T *C-16080, *C-25466, *M-15760
LINDVALL, T C-00965, *C-08953, C-09648, D-00209, G-00208, *G-09659
LINNELL, R H *C-02786
LLEWELLYN W F B-31463
LLOYD L L F-23187
LOEHR R C *B-22550
LONDON S A *C-27733
LONGWELL, D H B-02279
LOQUERCIO, P A *A-08912
LORENTZ F *B-35609
LOZANO E R *A-27451
LOZANZO, E R *A-05549
LUDINGTON D C *B-35879
LUDWIG J H *K-16263
LUDWIG, J H *A-05007
LUEDTKE, K D A-09853, C-05614, *C-09860
LUHR, R A C-08268
LUHR, W B-07374, B-07530, B-07531
LUKACS J *N-19060
LUNCHE R G *A-24527, *B-14341

M

MACHIYAMA T A-25056
MACKAY D A M *C-35648
MACKENZIE, V G D-06535
MACLAREN J W *M-24091
MAEDA T *A-31155, *A-31157
MAGA, J A *K-00157, *K-11734
MAIER A *B-31301, *B-31472
MAJOR, W D A-12621, *B-09655
MAKSIMOV V F B-22400
MALARKEY, E J *B-11158
MALLATT R C *B-22435
MARIA G *B-14013
MARKANT H P *B-14118
MARN W L *B-12434
MARSHALL W F *A-12505, *A-14914, C-20100
MARTIN LOF R *A-25205
MARTLAND L *L-12376
MARUSHIMA Y B-14203
MARUYA H M-14491
MASON, L B-09733
MASSIELLO, F *B-05930
MASUDA, S I *B-03976
MATSUDA S B-12480, C-20460
MATSUI T D-20355
MATSUSHITA A C-32467
MATSUSHITA, H *C-10983
MATTESON, M J *B-05408
MATULA R A A-25455, A-34766
MAZITOVA, R M *N-05235
MCCABE L C *A-35693, *B-35595
MCCABE, L C A-07561
MCCALDIN R O A-00402
MCCALLA T M A-35564
MCCARTHY, J L B-05408, B-05409
MCCAULEY R F *A-35599
MCGINNITY J L *C-19051
MCGINNITY, J L B-09813
MCKEAN, W T JR *A-01885, *B-04950, *F-12662
MCLAUGHLIN A F-16696
MCLOUTH B F *B-14609
MCLOUTH, B F A-10699
MCLOUTH, M E *D-02212
MEDALIA, N Z *M-00376, *M-00844
MEITES L *B-14757
MELLOR J F JR *B-08946
MELVIN W W JR A-27451
MELVIN, W W JR A-05549
MERKEL J A *C-13099
MERRION D F *A-27129
MERRITT, C JR C-03354
MERZ O *A-23843
MEUTHEN B *A-34585
MEYER, W E *A-05527
MILKS D *A-25455
MILLINGTON B W *A-12377
MILLS, H A B-02729
MILLS, J L *B-06088, *B-06412, *C-05614

MINER J R C-13099
MINER S *A-17603
MISHIMA M C-17627
MITADERA T B-29437
MITCHELL G E *B-22353
MIURA M *B-31945
MIURA T A-21857, C-17638, C-32467
MIYAGAWA T *B-32498
MIYAGI S B-29437
MIYAHARA K *B-33617
MIYAJIMA H *B-35803
MIYOSHI H *M-30896
MIZUKI T M-30896
MNATSAKANYAN A V *K-21083
MOEHLE F W *B-25694
MOLOS, J E *B-05862
MONSCVITZ J T *B-22837
MOORE H C-29858
MORGAN J P *B-23901
MORIKAWA T *B-23002
MORITA M *L-30153
MORRISS F V *A-24459
MORTON F *F-16696
MORTSTEDT, S E B-06280
MOSER K M G-27137
MOULTON D G *C-12359, *G-19599
MOUM S G A-35673
MUELLER J H *J-29299
MUELLER P K *C-29858
MUIR A J *B-31631
MUKHERJI A K C-20192
MULIK J D C-19051, *C-34863
MUNAKATA Z C-17629
MURAHARA M *B-33398
MURAKAMI M *A-17462
MURANAKA H B-17635
MURATA K B-32799
MURATA M *D-20355
MURATA T C-28787
MURPHY R P *A-34290
MURRAY F E *A-12507, *B-14113, B-15690
MURRAY, F E *B-05808
MURRAY, R C B-09794, *B-09836, *B-09842, *B-09849

N

NAGATA K A-25056
NAGAYASU M M-13980
NAGIRA T M-14491
NAKA K D-20355
NAKAGAWA B *C-30811
NAKAGAWA F *C-17641, *C-21858
NAKAI Y *B-30530
NAKAJIMA K *B-33742
NAKAJIMA S *B-19218
NAKAMURA K *C-17639
NAKAMURA N *A-17236
NAKANO T *B-15948
NAKAYAMA H *D-29349
NAMIKI T A-21857, C-17638
NATUSCH D F S *A-34287
NAVARRE, A J A-12621
NEILSON, A J A-04785
NELSON, B *M-08698
NETZLEY, A B *B-09830
NEUHAUS W *G-21712
NEUMAN W G-34686
NIKI S M-27680
NISHIDA K B-14488, *B-26056, *B-29448, C-30704, *D-26304
NISHIYAMA K *M-13980
NISHIYAMA, K A-06240
NOBUO M *F-12449
NOLAN W J *B-23538
NOLAN, M *D-01202
NOSE Y *D-23149, *D-23152
NURANAKA K *B-32497

O

O DONNELL A A-25327
OBATA K *B-31911, C-21858, C-30811
OBERING E A *B-13697
OCHI J *F-26529
OCHS H J *B-23493
ODAIRA T *B-20628, B-24380
ODONNELL A *A-34964
OE, M A-06240
OGATA M *G-28175
OHIRA M *M-14491
OHIRA T *C-17628, *C-27791
OHKITA T *C-23004
OKA M *C-29337
OKADA S *A-32878
OKAMOTO M *A-26826
OKAMOTO Y *A-28614
OKATSUKA H *B-26296
OKAZAKI T B-26308
OKEY R W A-32385
OKHOTSKAYA, V N N-05235
OKITA T *C-17627, *C-20202, *C-21859, *C-24814, *C-26547
OKUBO S *A-27972
OKUDA M A-25056
OKUMA K G-28175
OKUNO T A-29599, *A-29842, B-12480, *B-15772, B-20625, *B-22988, B-26836, *B-29131, *B-29978, C-20460, *C-20624, *C-26837
OLOMAN C *B-15690
OLSSON H *B-23456
OMORI J G-28175
ONISHI I *B-26568
ONISHI, T B-03976
ONO S *B-33120
ONO, S *B-04664
OSHIMA T C-16134
OSTERLI V P *B-25977
OTOBE S B-17395
OTT, R R A-00393
OWENS, V P *B-05880, *B-10994
OYAKE T A-17631, D-17630

P

PACHERNEGG S J *A-33648
PADRTA F G C-14607
PAPETTI R A *A-33828
PARDOE E S *B-25594
PARISH H C A-21395
PARTEE F P *L-34755
PATCZYNSKI, R *B-10588
PAULETTA, C E B-00257
PAULSON E G *B-22518
PAULUS H J B-14609
PAULUS, H J D-02212
PEARSALL, H W C-05170
PECKHAM B W *M-26725
PEREZ J M *A-20101
PERRINE R L *A-26911, *B-26254
PETERSON, C M *A-10699
PETROVA, M S *C-11486

PEYRON L *F-24354
PHELPS A H JR C-32676
PHELPS, A H *B-05332
PHELPS, A H JR *B-07429, *C-05898
PICKEL, W *A-07394
PIERCE L B C-29858
PIRCON L J *B-12346
POLGLASE, W L *B-09852
POLKOWSKI L B C-35865
PORTER, E V *D-03418
POSSELT, H S *B-04627, B-06363
POTTINGER J F A-34290
PRICE L A-28885
PRICE, L A-01644, A-04879, A-11144, B-04950
PROCHAZKA V *C-29243
PROWLER M E *A-27235
PUBLIC HEALTH SERVICE *D-09590, *D-09592, *L-09677
PUCHKIN, B I N-05235
PURDOM P W *C-32022
PUSTINGER J V JR *A-21978

R

RAMSDELL, E W B-07434
RAO D N H-20028
RASMUSSEN R A *A-19814
RAYZACHER B *A-33883, B-27719, *B-28108
RECKNER L R *A-35635, *C-14606, *C-16442, *C-21693, D-18231
RECKNER, L *C-03542
RECKNER, L R *C-07266, *D-00251
REED, R D *B-04838
REED, R J *B-05852
REHM, F R *C-04117
REIDIES, A H B-04627
REPORT OF A SURVEY ON ENV *D-31371
RICKETTS C *B-31178
RISK J B B-15690
RISMAN A A-27821
ROBERSON J E *B-16807, *B-21051
ROBERTS A J B-14609
ROBERTS, A J A-10699
ROBERTSON, D H C-03354
ROBINETTE, G *B-09407
RODERICK, W R *F-03173
ROMANO, A H *G-07091
ROSE A H A-31880
ROSE, A H JR *B-01613
ROSEN, A A *A-07089
ROSNER, D E F-07681
ROSS R W L-15554
ROSSANO A T N-19060
ROSSANO A T JR C-35956
ROSSANO, A T JR *A-00393
ROTELLA W J B-13971
ROTH L A-30701, A-35581
ROTHE W *B-20369
ROUNDS, F G *C-05170
RUBIN E R C-27934
RUBIN M F-19061
RUDOSKY, C B-11158
RUE P G L *A-20276
RUEB F *B-24969
RUMSEY D W *K-21918
RUTHERFORD J G *B-21220
RUUS A L *B-13334
RYAZANOV, V A *D-05256, *K-05117

S

SAARY Z B-16890
SABLESKI, J J *C-11167, *L-03540, *M-00487
SAFFERMAN, R S G-07091
SAIKADO H *C-34047
SAITO, H B-03976
SAKATA E *C-29843
SAKUMA K *C-17638
SAKURAI T B-24380
SALLEE E D *B-14895
SAMSON P C C-14607
SANDERSON, H P *D-00690
SANDOMIRSKY, A G *B-00257
SANO I *C-33349
SANTRY, I W JR *B-04666
SAPP J E B-13398
SAPPINGTON W M C-27733
SARKANEN, K V A-01885, B-04950, *B-04951, B-04952, B-04953, F-12662
SASAKI M D-26304
SATO S A-17632, A-17633, *B-20709
SAVERY C W A-25455
SAWATANI T *B-29745, *C-12492, C-32467
SAWAYA T *A-19899, *C-33577
SCHAFER L J D-23845
SCHELLHASE, C H B-02729
SCHIELE G *B-24065
SCHIRZ S *B-25858
SCHMIDT, R C *A-05335
SCHNEIDER W B-15153
SCHOEFFMANN E *B-15153
SCHOENING M A *A-14580
SCHUENEMAN, J J *A-02765, M-01069
SCHUMANN, C E *A-05608
SCHWARTZ B B G-23298
SCHWARZ, H B-07374, B-07530, B-07531

SCOTT D H A-14972
SCOTT W E A-35635
SCOTT, W E C-02786, C-03542, D-00251
SEASE, W S *B-06688
SEIZINGER, D E D-00241
SELTZER W *A-35673
SEVERES, R K B-03966
SHAFFER D E A-29698
SHAH I S *B-14094
SHAH, I S *B-06859, *B-09733, *B-11008, *B-11009
SHAW A C *F-13670
SHAW F M *L-31084
SHERWOOD P T *A-31323
SHEVKUN, O N C-11486
SHIBAHARA T *B-30782
SHIEH W *B-35566
SHIGENO K *B-17637
SHIGETA F C-17627
SHIGETA Y A-20706, A-28527, *B-12482, *B-23117, *B-26057, *B-27288, *B-29601, *C-13627, *C-17640, *C-20264, C-21866, *C-27355, C-30689, *C-33121, *C-35751, *L-30149, M-27680
SHIH, T T *B-04953
SHIH, T T C *B-04952
SHIMODA M B-34073
SHIRAKAWA H D-17630
SHOJI H *B-14488, *C-30704
SHORT W *E-26550
SILVEY J K G C-13143
SIMONS H E B-22435
SINGER R E *B-31700
SKALA H *C-14607
SKEEL, R T A-07089
SKINNER C F *C-24429
SMARSH J B-27732
SMITH D B *A-14972
SMITH H O *C-18093
SMITH, L K A-09853, B-06412, C-05614
SMITH, W S L-00871, *M-01069
SMOYER J C *A-29698
SOBEL A T B-35879
SODA, R C-10983
SOLOMIN, G I *G-05949
SOMERS J H *A-30851, A-33564
SONE H *A-17632, A-17633
SPINDT R S *A-33564
SPONSEL K *B-21702
SPRINGER K J A-34891, B-20120, *B-20877, *B-20878, *B-23067, *M-23408
SPRINGER, K J A-06039, *B-01867, *B-05490, *B-06453, *B-06525, *B-06979, *B-07479, B-09608, *L-04841, *L-04888
SQUIRES R E C-16442, C-21693, D-18231

STAHMAN R C *B-20120
STAHMAN, R C *B-09608, L-04841
STANLEY, W J A-08912
STARKMAN, E S *A-01565, *B-08663
STAYZHKIN, V M *G-05946
STEIGERWALD B J *A-31880
STEINBACH, W A-08373
STEINBERG J L A-25455
STENBURG, R L *B-02427
STEPHENS E R *C-28141, *E-19849
STEPHENSON, W D B-11009
STEVENS R K C-34863
STIER A G-34686
STOCKHAM J *A-25327
STOCKHAM, J C-09620
STOCKMAN, R L D-01949
STOKES R *B-25017
STOKES, H E B-02729
STONE R *B-19705
STORMONT D H *B-19850
STRAUSS W *B-14354
STRAUSS, W *B-04669, *B-05093
STRESEN REUTER J *B-18050
STROBEL J E A-21978
STUBBS R C C-13367
STUECKRAD J *A-33719
STUMPH T L *L-12511, *L-16330
STUTZ, C N *B-02488
STYLES, H E *A-09255
SUDO T C-16134
SUGAI R C-21859
SUGIMOTO N A-25056
SUGIURA K *A-28295
SUGIYAMA H C-17641, C-21858
SULLIVAN D C *C-18194
SULLIVAN J L *A-20134
SULLIVAN R J *A-20553
SULLIVAN, J H *C-03354
SULLIVAN, J L *B-01414
SUMMER W *B-25224
SUMMER, W *B-05624
SUTTON G P *A-31602
SUZUKI F *B-26125
SUZUKI K *K-35146
SUZUKI T D-26304
SUZUKI, Y *A-06240, C-10983
SWWENY J W *B-22838

T

TADA M *B-14940
TADA T A-26826
TADA, O *C-06112
TAJIMO M B-17238
TAKADA K A-29599
TAKADA S A-26826, C-30704
TAKAGI S *C-32[illegible]
TAKAGI S F *F-13107, *F-19102
TAKAGI, S F *F-11132
TAKAHASHI H B-34073
TAKAHASHI S C-28787

TAKAHASHI T C-17629, *F-29649
TAKAHASHI Y B-17238
TAKAMATSU Y *A-29455
TAKEDA M *B-17636, C-17628
TAKEI K *B-24845
TAKEUCHI H F-13107
TAKIJIMA T A-17632
TALENS, P G *B-09827, B-09854
TAMAN S *B-17635
TANAKA H B-12480, *B-17238, C-20460
TANAKA I *B-14956, *B-15170
TANAKA S C-31222
TARALA F E *B-19221
TATEMATSU K B-30479
TAYLOR E F *B-27605
TAYLOR, F R C-03542
TELLER, A J *B-06103
TERABE M *B-17293, *C-23107
TERANISHI R F-19063
TERAO K *B-29437, *B-29533
TESSIER, K C *B-11220, *B-11234
TEYOGI N *B-24988
THOM N G *D-24162
THOMAS J F B-11673, B-12506, B-20258, *F-16828
THOMAS, E *B-07434
THOMAS, J F A-06981, A-08359, C-08354

THUMAN W C *N-19088
TICHATSCHKE J *A-30218
TIMBY E A *B-34778
TIRADO, A A B-03946, *B-04045
TISI G M *G-27137
TITOVA G A B-29278
TOBIAS G S B-31211
TOHATA H *B-28756
TOISHI, K *I-05463
TRIEFF N M *C-20192
TRIEFF, N M *C-10534
TRUITT, S M B-05852
TSUCHIBASHI S C-20264
TSUCHIDA T B-17635
TSUCHIHASHI S A-20706
TSUIJI M *B-20625, C-20624
TSUJI B-29978
TSUJI A C-32467
TSUJI M A-29599, A-29842, B-12480, *B-26836, B-29131, C-20460, C-26837
TUERKOELMEZ S *B-14692, *B-16365
TURK A *B-20796, *B-32070, *C-05813, *D-18231, *F-16455
TURK, A *B-03499, *B-10005, *C-05396, *L-05129
TURPIN A J *B-27793
TUTTLE, W N F-01784
TYLER, W S *B-05929

U

UEDA J A-26826, D-26304
UEKI S G-28175
UENO S D-23152

V

VALENTINE J P B-22838
VAN DONKELAAR A B-25950
VANDAVEER F E *B-23008
VAUGHAN H L *D-12426
VEDERNIKOV V G *B-22400
VENEZIA, R A *L-01604
VIESSMAN, W *B-00358
VINCENT, E J *B-09813, B-09849
VOGEL, H E *B-08467
VOGELHUBER W W *A-21395
VOGH J W *C-16781
VOS A W D *B-27732
VREBOS, J A-09255

W

WADA K B-26567
WADA M *L-32796
WADE W R A-20125
WAGNER T O *C-14680
WAID D E *B-30738, *B-32559
WAITKUS, J B-06366, B-08506
WALDOCK K T F-13670
WALKER A B *B-14687, *B-20817
WALKLEY, J A-09175
WALLACH, A *B-04533
WALSH R T *L-23754
WALSH, R T A-04860, *A-09853, *B-09794, B-09852, *B-09854, C-05614

WALTHER J E *B-16842, *B-17409
WANNER, H U G-07821
WATANABE M C-23004
WATANABE S *C-12479, *C-16540
WEHNERT K *L-26511
WEINER J *A-30701, *A-35581
WEISBURD, M I *B-00975
WELSH G B D-12426
WELSH, G B *D-03431, *L-02840
WENZEL, H F J *G-03788
WERTZLER J E *B-26944
WESSLER M A *A-11692
WESTALL G B JR *B-27818
WESTERBERG, E N B-09933
WESTON R F *B-29251
WHITFIELD J C-35541
WIDMAN B W C-27733
WIENKE K *C-12942
WILBY F V *C-14108
WILDER O H M B-12346
WILKES J O E-22335
WILLIAMS, A F *A-10075
WILLIAMS, J D *L-00871
WILLIAMSON D E A-32385
WILSON D F *A-33983
WILSON E B *L-32626
WILSON, K W G-00177
WIMETTE, H J C-03542
WITTES J T D-18231
WOHLERS H C *C-22958
WOHLERS, H C *C-08066
WOOD, C B-01867
WRIGHT R H A-14580, *A-24903, *B-27357, *F-17801, *F-32271
WRIGHT, R H *B-06106
WRIST P E *L-31465
WROMBLE, R F D-00751
WYSE G A F-19102

Y

YAGI Y C-30704
YAJIMA T A-32855
YAMAGUCHI K D-26304
YAMAMOTO H K-35146
YAMAMOTO N *K-31968
YAMAMOTO T B-12480, B-20625, B-26836, *C-20460, C-20624, C-26837, C-30704
YAMAMURA Y *B-27541
YANAGI F *B-28146
YARGER, H J A-12621
YASUI N *A-26048
YOCOM J E *B-20824
YORK J L E-22335
YOSHIDA M *C-26309, *C-29929, *F-22429, *F-22430
YOSHIOKA T C-17641
YOUNG F A C-18194
YOUNG, F A C-08268
YUKAWA N *B-26843

Z

ZEIDBERG, L D M-01069
ZESCHMANN E G C-16298
ZESCHMANN, E G B-07224, B-08604
ZILLES, P A-09175
ZIMMER C E D-31760
ZINN R E A-22860

SUBJECT INDEX

A

ABATEMENT A-20553, A-24500, A-26911, A-31882, A-32465, A-35581, B-01672, B-06103, B-08364, B-09655, B-24743, B-25479, B-26087, B-32057, C-08678, D-09590, D-09592, D-25291, D-29973, L-04942, L-07781, L-09677, L-12511, L-15691, L-17258, L-25446, L-26511, L-26940, L-27184, L-27185, L-27677, L-27678, L-27679, L-28348, L-28363, L-29679, L-29813, L-30149, L-32147, L-32171, L-32352, L-32354, L-32382, L-32383, L-32796, L-32893, L-33117, L-33725, L-34033, L-34256, L-35694, L-35752, M-08698, M-24091, M-31071
ABSENTEEISM D-33108
ABSORPTION A-20553, B-00358, B-00379, B-01563, B-02427, B-03499, B-04773, B-04882, B-04887, B-04952, B-06106, B-08104, B-09508, B-09784, B-09836, B-09922, B-10588, B-11059, B-13072, B-13812, B-14118, B-14671, B-15690, B-17293, B-17314, B-17635, B-20628, B-20817, B-20824, B-22400, B-22525, B-22838, B-23371, B-23456, B-23967, B-24969, B-27674, B-29745, B-30530, B-30809, B-31062, B-31178, B-31456, B-32634, B-33122, B-34073, B-35803, C-03010, C-05426, C-06112, C-09619, C-09620, C-10016, C-10534, C-17288, C-17641, C-20538, C-25065, C-35865, C-35956, F-01784, F-14987, F-29649, G-07091, I-05463, N-20495
ABSORPTION (GENERAL) B-20369, B-21647, B-25224, B-32615
ACETALDEHYDE A-32475, B-02427, B-04627, B-26014, B-29437, C-03354, C-08066, C-11123, C-31924, D-29349, F-29649, G-00177
ACETIC ACID A-17631, A-32411, A-32475, B-24969, C-08066, C-09521, C-11123, C-14109, C-18093, C-32269, D-23152, D-31371
ACETONE A-32855, A-33713, B-04627, B-05409, B-16842, C-07214, C-08066, C-08356, C-11123, G-00177, K-05947
ACETYLENES A-05007, B-03129, C-08066, C-08354, D-00251, D-31760
ACID SMUTS K-07766
ACIDS A-00393, A-05007, A-07394, A-07561, A-17198, A-17631, A-29599, A-29842, A-30218, A-31880, A-32411, A-32475, A-32855, A-34018, A-34766, A-34964, B-00975, B-01414, B-03129, B-03966, B-04943, B-05332, B-06106, B-06280, B-07362, B-07531, B-09784, B-09827, B-09839, B-09849, B-09852, B-14967, B-19493, B-24969, B-26254, B-29363, B-30350, B-31091, B-31233, B-32099, B-32119, B-32166, B-33077, C-01289, C-03010, C-08066, C-09521, C-11123, C-11167, C-14109, C-14607, C-17044, C-18093, C-20460, C-23107, C-28141, C-28393, C-29269, C-31924, C-32268, C-32269, C-33577, C-35865, C-35956, D-06535, D-07572, D-09590, D-09592, D-23152, D-25996, D-29973, D-31371, D-33108, D-35764, E-19849, F-23187, F-29649, G-05942, G-05946, G-21125, G-35570, I-19325, K-07766, K-31516, L-00054, L-07781, L-27677, L-27678, L-27679, L-32354, L-32382, N-03438
ACRIDINES B-04300
ACROLEIN A-05608, A-06039, A-28527, A-31044, A-32855, A-34891, B-00286, B-02427, B-04627, B-05929, B-20877, B-20878, B-26014, C-02786, C-03542, C-07266, C-11123, C-31924, C-32880, D-00251, E-19849, F-29649, G-00177, L-04888
ACUTE G-07821
ADAPTATION C-08953, C-21652, C-26966, G-06323
ADMINISTRATION A-00402, A-02765, A-08912, A-11700, A-12832, A-12834, A-16058, A-17198, A-23313, A-23314, A-24350, A-25638, A-26826, A-26911, A-29698, A-30851, A-31263, A-31323, A-32465, A-35622, B-00504, B-00975, B-01505, B-01672, B-01867, B-02794, B-03129, B-04882, B-06280, B-06636, B-07971, B-08364, B-09791, B-11059, B-16842, B-19850, B-25479, B-26087, B-30865, B-31178, B-32057, B-34868, C-03010, C-04117, C-11167, C-27248, C-29891, C-30374, D-00751, D-01202, D-01949, D-02212, D-02331, D-02339, D-03001, D-03017, D-03418, D-03431, D-03459, D-03506, D-03514, D-05481, D-06535, D-09590, D-09592, D-12426, D-12648, D-16062, D-23411, D-23845, D-25291, D-25780, D-25996, D-29973, D-31371, D-33539, D-35764, G-28175, G-34667, K-00157, K-11734, K-31968, L-00054, L-00549, L-00871, L-01528, L-01604, L-02295, L-02840, L-03540, L-04841, L-04888, L-04942, L-06732, L-07235, L-09677, L-10567, L-14616, L-15691, L-17258, L-19059, L-22343, L-25446, L-26940, L-27184, L-27185, L-28348, L-29679, L-29813, L-30153, L-30688, L-32147, L-32352, L-32354, L-34256, L-34755, L-34926, L-35511, M-00376, M-00487, M-00844, M-13980, M-23408, M-24091, M-24768, M-27680, M-30896, M-31071, N-03438, N-32254
ADSORPTION A-03825, A-04860, A-09853, A-20553, A-33188, B-00286, B-00358, B-01352, B-01563, B-03499, B-03972, B-04666, B-04669, B-04943, B-05093, B-06103, B-09784, B-09794, B-09854, B-10005, B-10588, B-11059, B-12482, B-13072, B-13812, B-14692, B-16113, B-16365, B-17293, B-20625, B-20709, B-20817, B-20824, B-22518, B-23456, B-24380, B-24969, B-26128, B-26836, B-28047, B-29437, B-29448, B-29601, B-30530, B-30738, B-30809, B-31233, B-32070, B-32634, B-32768, B-33120, B-33122, B-34778, B-35609, C-05426, C-09619, C-10016, C-10534, C-10693, C-17288, C-20460, C-25065, C-27475, C-31924, C-32467, C-35956, D-00373, F-01784, G-00177, G-07091, L-14028, L-32796, N-05235, N-20495
ADSORPTION (GENERAL) B-25224, B-28047
ADULTS C-14108, D-18231, M-00844, M-01069
ADVISORY SERVICES A-35622, D-29973, L-00549, L-12376, N-19088
AERODYNAMICS D-00373, N-20495
AEROSOL GENERATORS A-02001, A-10075, B-03976, B-04361, B-05532, B-33380, L-30149
AEROSOLS A-05007, A-07561, A-32653, B-00257, B-00975, B-01508, B-02047, B-07530, B-07531, B-09784, B-09791, B-09836, B-09842, B-14895, B-20817, B-24969, B-30124, B-35660, C-03542, D-00373, D-09590, E-19849, G-00177, G-05942, M-26725
AFTERBURNERS A-04860, A-06039, A-07394, A-08912, A-09853, A-10699, A-17603, A-20276, A-21887, A-24007, A-25179, A-29332, A-32465, A-33188, A-34228, A-34585, B-00257, B-00504, B-00571, B-01414, B-01867, B-02047, B-02725, B-03499, B-04300, B-04669, B-05852, B-06088, B-06366, B-06412, B-06453, B-06979, B-07362, B-07479, B-09508, B-09608, B-09784, B-09791, B-09794, B-09813, B-09819, B-09830, B-09849, B-09852, B-09854, B-11059, B-11136, B-11137, B-13971, B-14341, B-14757, B-14895, B-19493, B-19705, B-19850, B-20817, B-20824, B-21888, B-22525, B-23067, B-23371, B-23967, B-24988, B-25554, B-25977, B-26128, B-26308, B-26843, B-26944, B-27154, B-27401, B-27793, B-30738, B-30773, B-31062, B-31167, B-31400, B-31631, B-32559, B-32847, B-33077, B-34679, C-05614, C-24429, C-25065, I-19325, J-29299, L-04888
AGE K-11734
AIR CONDITIONING EQUIPMENT A-12998, B-08104, B-14354, B-24810, B-25711, B-29761, B-31211, B-31233, B-31354, B-32913, B-34778, G-06323, L-29975
AIR POLLUTION EPISODES A-00525, B-09922, B-25479, D-02331, D-02339, D-09590, D-09592, D-25291, K-31968, L-00871
AIR POLLUTION FORECASTING A-03097, A-31759, C-27248, L-27185
AIR QUALITY CRITERIA A-25638, A-35581, B-26087, D-05256, D-09590, D-18231, K-05117, K-07766, K-11734, K-35146, L-10484, L-15688, L-32352, L-32566
AIR QUALITY MEASUREMENT PROGRAMS A-00402, A-02765,

A-11700, A-12832, A-12834, A-16058, A-17198, A-23313, A-23314, A-24350, A-25638, A-26826, A-29898, A-31263, B-02794, B-26087, B-31178, C-04117, C-11167, C-27248, C-30374, D-00751, D-01202, D-01949, D-02212, D-02331, D-02339, D-03001, D-03017, D-03418, D-03431, D-03459, D-03506, D-03514, D-05481, D-06535, D-09590, D-09592, D-12426, D-12648, D-23411, D-23845, D-25291, D-25780, D-25996, D-29973, D-31371, D-33539, D-35764, G-28175, K-11734, K-31968, L-00871, L-01604, L-02840, L-07235, L-14616, L-25446, L-27184, L-28348, L-29679, L-29813, L-32147, L-32354, L-34256, L-34755, M-00376, M-00487, M-00844, M-13980, M-23408, M-24091, M-24768, M-27680, N-03438, N-32254

AIR QUALITY MEASUREMENTS A-00402, A-00525, A-01885, A-03097, A-05335, A-05549, A-05608, A-07089, A-08912, A-10075, A-11692, A-12505, A-12832, A-14580, A-14914, A-16058, A-16135, A-17236, A-17631, A-22860, A-24350, A-25455, A-29599, A-29842, A-30389, A-30513, A-30701, A-30851, A-32653, A-32879, A-33564, A-33828, A-34018, A-35590, A-35635, A-35638, A-35693, B-00032, B-00286, B-00358, B-00504, B-00975, B-01505, B-01563, B-02729, B-03946, B-04533, B-05409, B-06280, B-09608, B-09784, B-09827, B-10277, B-14967, B-16842, B-22353, B-24380, B-26087, B-31354, B-31400, B-32099, B-32119, B-32900, B-32913, C-00178, C-02786, C-03542, C-04117, C-04883, C-05170, C-09619, C-09860, C-10029, C-10534, C-12492, C-13099, C-13627, C-13749, C-15287, C-16754, C-18093, C-20192, C-23004, C-23106, C-27248, C-29269, C-29337, C-32022, C-32467, C-32880, C-35541, C-35949, D-00209, D-00251, D-00373, D-00690, D-01202, D-01949, D-02212, D-02339, D-03001, D-03017, D-03431, D-03506, D-03514, D-05481, D-06535, D-07572, D-09590, D-09592, D-12426, D-12648, D-16062, D-16635, D-16636, D-18231, D-20355, D-23411, D-23845, D-24162, D-25291, D-25780, D-25996, D-26304, D-27255, D-29349, D-29973, D-31371, D-31760, D-33108, D-33539, D-33723, D-35764, F-12449, F-16455, G-00177, G-05942, G-05943, G-05946, G-05949, I-19325, J-34518, K-05947, K-07766, K-11734, K-21083, K-21084, K-31286, K-31516, K-31968, L-00054, L-00973, L-01604, L-02840, L-04942, L-07235, L-09604, L-09677, L-10484, L-10567, L-14616, L-15688, L-19059, L-27184, L-29813, L-32147, L-32171, L-32352, L-32382, L-32383, L-32626, L-32893, L-33672, L-34926, L-35511, L-35694, M-00376, M-00844, M-01069, M-26725, N-03438

AIR QUALITY STANDARDS A-23843, A-24500, A-25638, A-32878, A-33719, B-00504, B-00552, B-00975, B-03129, B-09922, C-02786, C-09716, D-01202, D-05256, D-16635, D-16636, D-18231, G-05942, G-05943, G-05946, G-05949, G-07821, G-21125, G-35570, K-05117, K-05947, K-07766, K-11734, K-20194, K-21083, K-21084, K-21918, K-27403, K-30870, K-31516, K-31968, K-35146, L-00549, L-00871, L-00973, L-01604, L-09677, L-14616, L-15688, L-27678, L-27679, L-32382, L-32383, L-32566, L-33117, L-33672, L-33725, L-34755, M-00376, M-00844

AIR RESOURCE MANAGEMENT C-32022, D-33539, L-25446, L-20511, L-32147, M-24091

AIR-FUEL RATIO A-01565, A-02001, A-05335, A-05549, A-09255, A-10075, A-12377, A-14297, A-20118, A-21700, A-27249, A-27986, A-35590, B-01613, B-04361, B-06280, B-07224, B-08663, B-19850, B-21220, B-30865, B-32119, B-35566, N-20495

AIRCRAFT A-05549, A-27451, A-32653, A-33719, B-08663, B-29628, B-34778, C-31924, D-01202, N-19060

AIRPORTS A-05549, A-32653, D-00690, D-01202, L-00054

ALABAMA D-03431

ALCOHOLS A-07089, A-07561, A-12083, A-23843, A-32855, A-33564, A-33983, A-34766, B-01414, B-04627, B-04838, B-04943, B-05409, B-06366, B-08506, B-09849, B-14692, B-16842, B-16890, B-21294, B-22400, B-22838, B-24090, B-26843, B-31233, B-32166, B-32956, C-03354, C-07214, C-08357, C-10983, C-11123, C-14109, C-14607, C-2793[illegible], C-29269, C-30704, C-30811, C-32269, C-34279, D-31371, D-31760, K-20194, L-32796

ALDEHYDES A-00393, A-02001, A-05007, A-05549, A-05608, A-06039, A-07561, A-08802, A-09175, A-09255, A-14116, A-14297, A-23843, A-24459, A-25327, A-26048, A-27249, A-27451, A-28527, A-29599, A-30218, A-30603, A-31044, A-31880, A-32465, A-32475, A-32855, A-33564, A-34018, A-34766, A-34891, A-34964, A-35590, A-35635, A-35673, B-00286, B-00975, B-01414, B-02427, B-04361, B-04533, B-04627, B-05808, B-05929, B-06280, B-06636, B-07224, B-07971, B-08497, B-09827, B-09830, B-09852, B-11234, B-14895, B-14967, B-15772, B-19493, B-20877, B-20878, B-21294, B-23008, B-24090, B-24845, B-24988, B-25594, B-26014, B-27674, B-29437, B-29533, B-31700, B-32166, B-33077, C-02786, C-03010, C-03354, C-03542, C-05170, C-06112, C-07266, C-08066, C-08953, C-10693, C-11123, C-11167, C-14607, C-16781, C-20100, C-27685, C-30704, C-30811, C-31924, C-32467, C-32880, C-34279, D-00241, D-00251, D-01949, D-03506, D-03514, D-06535, D-09592, D-23152, D-23845, D-25996, D-29349, D-31371, D-31760, D-33539, E-19849, F-17801, F-29649, G-00177, L-00054, L-04888, L-32147, L-32796, L-35511, N-03438

ALERTS B-25479, D-25291, K-31968

ALFALFA A-35564

ALIPHATIC HYDROCARBONS A-01885, A-05007, A-05549, A-16494, A-23843, A-26911, A-27235, A-27249, A-27451, A-28352, A-29599, A-32411, A-32475, A-33564, A-34891, A-34964, A-35564, B-00379, B-01414, B-01508, B-03129, B-04838, B-06636, B-07224, B-07362, B-09655, B-14341, B-14609, B-15772, B-16498, B-16890, B-22838, B-28118, B-29437, B-29978, B-32956, C-03354, C-05170, C-07214, C-08066, C-08354, C-09521, C-09619, C-10693, C-24814, C-26837, C-29269, C-30704, D-00251, D-23149, D-23152, D-29349, D-31760, F-16828, G-00177, G-00715, K-11734, K-21083, K-30870, N-20495

ALKALINE ADDITIVES B-09508, B-20709, B-30350, B-32070, B-32615, B-35803

ALKALIZED ALUMINA (ADSORPTION) B-06636, B-26908, B-32070

ALLERGIES A-20553

ALTITUDE A-29353, A-35638, B-04361, B-31223, D-09590, D-29973, E-14906, F-07681, L-29813, L-32566

ALUMINUM A-34018, B-03129, B-07362, B-09784, B-09791, D-33108, F-11132, G-00177

ALUMINUM COMPOUNDS A-32489, B-09849, B-24743, B-27401, B-28756, F-11132, I-05463

ALVEOLI G-23298

AMIDES C-11123

AMINES A-09853, A-17198, A-17631, A-19899, A-23843, A-29599, A-29842, A-31044, B-01508, B-02729, B-04300, B-04627, B-05624, B-05862, B-07530, B-07531, B-09849, B-09854, B-12480, B-15772, B-20625, B-26014, B-26836, B-27605, B-27674, B-29131, B-29363, B-29448, B-29745, B-29978, B-31302, B-31700, B-32099, B-32768, C-11123, C-13099, C-17627, C-17628, C-17638, C-17640, C-20202, C-20624, C-21858, C-23004, C-26547, C-26837, C-27685, C-27791, C-28141, C-29726, C-30704, C-30811, C-32467, C-33577, C-35865, F-29649, L-32796

AMINO ACIDS C-29508, C-32880, F-29649

AMMONIA A-07561, A-17198, A-17631, A-21857, A-29599, A-30218, A-30389, A-31044, A-31263, A-31880, A-32465, A-32855, A-33713, A-34018, A-35564, A-35673, B-01508, B-04627, B-04664, B-06280, B-07531, B-09854, B-14488, B-14967, B-17637, B-20625, B-20824, B-24969, B-26014, B-26618, B-26836, B-28118, B-29448, B-29978, B-31302, B-32768, B-33077, B-33122, C-03010, C-05170, C-11123, C-17628, C-17639, C-17640, C-17641, C-21858, C-23107, C-24429, C-24814, C-27355, C-27685, C-27791, C-29269, C-29726, C-30704, C-30811, C-31924, C-32880, C-35865, C-35956, D-03506, D-03514, D-06535, D-07572, D-09592, D-23152, D-23845, D-29973, D-33108, F-29649, H-00252, I-19325, K-35146, L-00054, L-04942, L-27678, L-27679, L-32796 L-32893, L-33725

AMMONIUM CHLORIDE A-17634

AMMONIUM COMPOUNDS A-07561, A-17198, A-17631, A-17634, A-21857, A-29599, A-29842, A-30218, A-30389, A-31044, A-31263, A-31880, A-32465, A-32855, A-33713, A-34018, A-35564, A-35673, B-01508, B-04627, B-04664, B-06280, B-07531, B-09854, B-14488, B-14967, B-17637, B-20625, B-20824, B-24969, B-26014, B-26618, B-26836, B-28118, B-29448, B-29978, B-31302, B-32099, B-32768, B-33077, B-33122, C-03010, C-05170, C-11123, C-17628, C-17639, C-17640, C-17641, C-21858, C-23107, C-24429, C-24814, C-27355, C-27685, C-27791, C-29269, C-29726,

C-30704, C-30811, C-31924, C-32880, C-35865, C-35956, D-01949, D-03506, D-03514, D-06535, D-07572, D-09592, D-23152, D-23845, D-29973, D-33108, F-11132, F-29649, G-28175, H-00252, I-19325, K-35146, L-00054, L-04942, L-27678, L-27679, L-32796, L-32893, L-33725
ANALYTICAL METHODS A-01644, A-03825, A-05549, A-05608, A-06981, A-08359, A-08373, A-08802, A-10075, A-14580, A-15297, A-16494, A-17603, A-17631, A-17633, A-19814, A-20101, A-20557, A-21661, A-21978, A-23843, A-24350, A-25228, A-25327, A-25455, A-27451, A-28527, A-29698, A-30687, A-30701, A-31044, A-31263, A-31602, A-32411, A-32475, A-33564, A-33713, A-34287, A-34766, A-34891, A-34964, A-35581, A-35635, B-00032, B-00286, B-00358, B-00379, B-00571, B-00975, B-02279, B-03807, B-03966, B-04045, B-04361, B-04882, B-04887, B-05408, B-05409, B-05808, B-06363, B-06366, B-06453, B-06525, B-06979, B-08364, B-08497, B-08506, B-09830, B-10277, B-11843, B-12480, B-14692, B-14967, B-16842, B-17636, B-20628, B-23319, B-23371, B-24380, B-29323, B-32099, B-32166, B-32302, B-32681, B-34679, B-35566, C-01289, C-02786, C-03010, C-03542, C-04883, C-05426, C-06112, C-06381, C-06526, C-07214, C-07266, C-08066, C-08354, C-08355, C-08356, C-08357, C-08358, C-09476, C-09521, C-09619, C-09620, C-09657, C-09860, C-10016, C-10029, C-10534, C-10593, C-10693, C-12488, C-12942, C-13099, C-13143, C-13367, C-13749, C-13969, C-14197, C-14680, C-15287, C-16134, C-16442, C-17288, C-17627, C-17628, C-17629, C-18093, C-19051, C-20100, C-20192, C-20202, C-20264, C-20460, C-20624, C-21859, C-22431, C-23004, C-23107, C-23755, C-24814, C-26547, C-27121, C-27248, C-27355, C-27475, C-27685, C-27733, C-27791, C-28141, C-28787, C-29337, C-29508, C-29726, C-29843, C-29858, C-30014, C-30374, C-30704, C-31222, C-31924, C-32022, C-32467, C-32795, C-32880, C-33577, C-34047, C-34279, C-34863, C-35541, C-35648, C-35751, C-35865, C-35949, C-35956, D-00209, D-00251, D-05481, D-23098, D-29349, D-31371, D-31760, F-01784, F-10308, F-13670, F-19061, F-19063, G-00177, G-03788, G-05949, G-21359, G-35570, G-35671, I-05463, K-27403, K-31286, L-00054, L-04888, L-35511, L-35752, N-19088, N-20495
ANEMOMETERS C-03010, C-35956, E-14906
ANIMALS A-00402, A-09175, A-17198, A-22973, A-25179, A-26911, A-30389, A-33713, A-33828, A-34018, A-35673, B-02427, B-03297, B-09827, B-09854, B-14453, B-22550, B-25379, B-25858, B-31302, B-33120, B-33398, B-35879, C-02786, C-03542, C-12359, C-13099, C-13749, C-23755, C-28141, C-32467, C-34972, D-00751, F-19102, F-33084, G-00177, G-00208, G-00715, G-05949, G-07821, G-19599, G-21125, G-21359, G-23298, G-35570, G-35671, H-00252, K-05947, K-11734, K-20194, K-21084, K-31968, K-35146, L-34926, M-00844, M-01069, N-03438
ANNUAL A-28352, B-31354, D-03001, D-23411, D-27255, D-29973, K-31516, K-35146
ANOXIA B-08497
ANTHRACENES A-01565, C-03542, D-00251
AREA EMISSION ALLOCATIONS K-11734, L-07235, L-09677, L-33725
AREA SURVEYS A-00402, A-02765, A-11700, A-12832, A-12834, A-16058, A-17198, A-23313, A-23314, A-24350, A-26826, A-29698, A-31263, B-02794, B-26087, D-00751, D-01202, D-01949, D-02212, D-02331, D-02339, D-03001, D-03017, D-03418, D-03431, D-03459, D-03506, D-03514, D-05481, D-06535, D-09590, D-09592, D-12426, D-23411, D-25780, D-25996, D-29973, D-31371, D-33539, G-28175, K-31968, L-00871, L-02840, L-14616, L-28348, L-29679, L-29813, L-34256, M-00376, M-00487, M-00844, M-13980, M-23408, M-24091, M-24768, M-27680, N-03438, N-32254
ARIZONA L-32382
AROMATIC FRACTIONS A-33564
AROMATIC HYDROCARBONS A-05007, A-05549, A-07089, A-07394, A-07561, A-10075, A-11692, A-23843, A-27451, A-29599, A-32855, A-33564, A-34766, A-34964, B-03966, B-04627, B-09839, B-16498, B-16842, B-16890, B-17906, B-28047, C-02786, C-03542, C-06112, C-07214, C-08356, C-08357, C-08953, C-09521, C-11123, C-11486, C-14109, C-14607, C-15287, C-18093, C-27121, C-27934, C-31924, C-32269, C-33349, D-00251, D-23149, F-17801, G-00177, G-05949, G-11476, L-32796, M-08698
ARSENIC COMPOUNDS A-26402, B-00975
ARSINE B-00975
ASBESTOS B-21938, B-26254, C-27248
ASBESTOSIS B-25479
ASHES A-31155, A-34228, A-34290, B-00025, B-00246, B-10009, B-30773, B-33077, B-33793
ASIA A-06240, A-16135, A-16494, A-17198, A-17236, A-17462, A-17631, A-17632, A-17633, A-17634, A-19899, A-20706, A-21661, A-21857, A-22987, A-23000, A-24500, A-25056, A-25228, A-26048, A-26574, A-26575, A-26605, A-26826, A-27669, A-27972, A-28295, A-28527, A-28614, A-29332, A-29455, A-29599, A-29842, A-30513, A-30687, A-31044, A-31155, A-31157, A-31263, A-32475, A-32855, A-32878, A-32879, B-03976, B-04664, B-08104, B-12480, B-12482, B-13072, B-14203, B-14488, B-14940, B-14951, B-14956, B-15170, B-15772, B-15948, B-16535, B-17238, B-17293, B-17314, B-17395, B-17403, B-17635, B-17636, B-17637, B-19218, B-20625, B-20628, B-20709, B-21647, B-22061, B-22538, B-22988, B-23002, B-23117, B-24380, B-24845, B-25379, B-26002, B-26014, B-26056, B-26057, B-26125, B-26128, B-26296, B-26308, B-26567, B-26568, B-26618, B-26836, B-26843, B-27288, B-27541, B-27548, B-27674, B-28146, B-28756, B-29131, B-29437, B-29448, B-29533, B-29601, B-29745, B-29761, B-29978, B-30260, B-30479, B-30530, B-30782, B-31091, B-31160, B-31223, B-31233, B-31354, B-31456, B-31911, B-31945, B-32099, B-32119, B-32497, B-32498, B-32768, B-32797, B-32798, B-32799, B-32847, B-32900, B-32913, B-33003, B-33120, B-33122, B-33380, B-33398, B-33617, B-33742, B-34073, B-35803, C-06112, C-12479, C-12487, C-12488, C-12492, C-13627, C-16134, C-16540, C-17288, C-17290, C-17627, C-17628, C-17629, C-17638, C-17639, C-17640, C-17641, C-20202, C-20264, C-20460, C-20624, C-21208, C-21858, C-21859, C-21866, C-22431, C-23004, C-23106, C-23107, C-24814, C-26309, C-26547, C-26837, C-27355, C-27475, C-27685, C-27791, C-28787, C-29337, C-29508, C-29726, C-29843, C-29929, C-30374, C-30689, C-30704, C-30811, C-31222, C-31924, C-32467, C-32795, C-32880, C-33121, C-33349, C-33577, C-34047, C-34279, C-35751, D-17630, D-20355, D-23098, D-23149, D-23152, D-25291, D-26304, D-27255, D-29349, D-29973, D-31371, D-33108, D-33723, D-35764, F-11132, F-12449, F-13107, F-19102, F-22429, F-22430, F-26529, F-29649, G-28175, I-05463, I-19325, K-31968, K-35146, L-14932, L-15691, L-17258, L-27184, L-27185, L-27677, L-27678, L-27679, L-28348, L-28363, L-29679, L-29813, L-29975, L-30149, L-30153, L-30688, L-32796, L-32893, L-33117, L-33725, L-35511, L-35752, M-13980, M-14491, M-27680, M-30896
ASPHALT B-03972, B-04627, B-09784, B-09791, B-09819, B-09836, B-24090, B-26125, D-09592, K-15926, K-31516, L-09677, L-15554
ASPIRATORS B-30809
ASTHMA A-30513, A-31759, D-02212, D-33108, L-01604
ATMOSPHERIC MOVEMENTS A-03097, A-05007, A-06240, A-10075, A-11700, A-20706, A-23313, A-24500, A-29353, A-29599, A-30513, A-33828, A-35564, A-35693, B-00975, B-01508, B-01672, B-09836, B-16842, B-26087, B-32900, C-00178, C-08066, C-08678, C-09660, C-11167, D-00690, D-01202, D-01949, D-02331, D-02339, D-03017, D-03418, D-03431, D-03459, D-03506, D-03514, D-06535, D-09590, D-09592, D-12648, D-25996, D-27255, D-31371, D-31760, D-33108, D-33723, E-14906, L-00054, L-02840, L-07235, L-29813, M-00487, M-27680, N-03438, N-19088
AUSTRALIA A-34290, B-04669, B-14354, C-16754, C-25065
AUTOMATIC METHODS B-00975, C-05426, C-09619, C-29843, C-32022, C-34279, D-29973
AUTOMOBILES A-05007, A-05549, A-05608, A-26048, A-28352, A-28614, A-30327, A-31323, A-31759, A-31882, A-32465, A-32653, A-33719, A-34018, B-00504, B-00975, B-06280, B-07224, B-08604, B-08663, B-17906, B-25711, B-31631, B-33077, C-16298, C-31222, D-25291, D-27255, D-29973, D-33108, K-00157, L-00054, L-09215, L-19059, L-22343, L-27185, L-27677, L-32147, L-34926, N-32254
AUTOMOTIVE EMISSION CONTROL A-01565, A-02001, A-05007, A-05335, A-05549, A-06039, A-08802, A-09255, A-10075, A-12377, A-12505, A-12998, A-14297, A-14914, A-20118, A-21700, A-23313, A-23314, A-26048, A-27129,

A-27249, A-27986, A-28352, A-30851, A-31323, A-31759, A-32653, A-35590, B-00504, B-01613, B-04361, B-05490, B-06280, B-06453, B-06525, B-06979, B-07224, B-07479, B-08497, B-08604, B-08663, B-09608, B-12133, B-17906, B-19850, B-20120, B-20877, B-20878, B-21220, B-23067, B-24988, B-25594, B-27401, B-28108, B-29437, B-29533, B-30260, B-30865, B-31400, B-31631, B-32119, B-35566, C-03542, K-00157, K-18294, L-03198, L-04888, L-09215, N-20495
AUTOMOTIVE EMISSIONS A-00393, A-01565, A-05007, A-05335, A-05527, A-05608, A-06039, A-08802, A-09255, A-11692, A-12377, A-12505, A-14116, A-14914, A-15297, A-16058, A-16135, A-20101, A-20118, A-20125, A-20134, A-20557, A-21700, A-24459, A-25327, A-26048, A-27129, A-27249, A-27451, A-28352, A-30327, A-30603, A-30851, A-31323, A-31759, A-32465, A-32653, A-33648, A-33719, A-34018, A-34766, A-34891, A-34964, A-35590, A-35622, A-35635, B-00504, B-00975, B-01613, B-06280, B-06453, B-06525, B-06636, B-06979, B-07224, B-07479, B-08497, B-08604, B-08663, B-09608, B-11220, B-11234, B-12133, B-17314, B-17906, B-20120, B-20877, B-20878, B-23067, B-24845, B-24988, B-25594, B-27401, B-28118, B-29437, B-29533, B-29628, B-30260, B-30865, B-31167, B-31233, B-31400, B-31631, B-33077, C-02786, C-03542, C-05170, C-06112, C-07266, C-09476, C-09620, C-14197, C-14607, C-14680, C-16298, C-16442, C-16781, C-20100, C-22448, C-23107, C-26966, C-27121, C-27248, C-27934, C-29337, C-31222, D-00241, D-00251, D-03001, D-03017, D-03431, D-03506, D-09592, D-18231, D-23411, D-23845, D-24162, D-25291, D-27255, D-29973, D-33108, E-19849, G-00177, K-00157, K-07766, K-1626[illegible], K-18294, L-00973, L-03198, L-04888, L-05129, L-07235, L-09215, L-09677, L-12376, L-25446, L-32147, L-32354, L-34926, L-35511, M-23408, N-19060
AZO DYE C-30014
AZOLES C-10693

B

BACTERIA A-04785, A-35599, B-03297, B-04666, B-06688, B-21006, B-22538, B-27336, B-33398, C-13143, C-21208, C-35956, D-31760, G-07091, G-07821
BAFFLES B-05930, B-12434, B-20754, B-21006, B-23594, B-32634, B-35554, G-06323
BAG FILTERS A-24903, A-26402, B-09794, B-09813, B-09815, B-09830, B-09849, B-16113, B-20817, B-22357, B-24810, B-30124, B-30530, B-31945, C-35956, D-02212, L-04942
BALLOONS C-00178, C-35956, D-09592
BARIUM COMPOUNDS A-34891, B-11220, B-11234, B-24845, F-11132, L-04888
BASIC OXYGEN FURNACES B-26254, L-01528, L-09677
BATTERY MANUFACTURING B-10277, B-32799
BELGIUM A-09255
BENZENE-SOLUBLE ORGANIC MATTER A-32653, A-33564, B-31400, C-03542, L-34926
BENZENES A-05007, A-07089, A-07561, A-32855, A-33564, A-34964, B-04627, B-28047, C-02786, C-03542, C-08356, C-08357, C-11123, C-14109, C-27121, C-31924, C-32269, C-33349, F-17801, G-00177, G-11476, L-32796
BENZO(3-4)PYRENE A-01565, A-08802, B-08497, C-03542, D-00251
BENZOIC ACID B-07362, B-19493, B-24969
BENZOPYRENES A-01565, A-08802, A-34018, B-08497, B-24988, B-29533, C-03542, C-32269, D-00251, D-33539
BERYLLIOSIS A-00393, A-00525, A-01644, A-01885, A-02001, A-03097, B-00032, B-00286, B-00358, B-00379, B-00504, B-00571, B-00975, B-01414, B-01505, B-01549, B-01563, B-02279, B-02729, B-03807, B-03946, B-03966, B-03976, B-04045, C-00178, C-00965, C-01289, C-02786, C-03010, C-03354, C-03542, C-03789, C-04883, D-00209, D-00241, D-00251, D-00373, D-00690, D-01202, D-01949, D-02212, D-03001, D-03017, D-03506, D-03514, F-01784, G-00177, G-00715, G-03788, L-00054, L-00871, L-00973, L-01604, L-02840, M-00487, M-01069, N-03438
BERYLLIUM COMPOUNDS C-09476
BESSEMER CONVERTERS B-31223, L-01528, L-09677
BIO-ASSAY C-29858
BIOCLIMATOLOGY D-33539, L-34256
BIOMEDICAL TECHNIQUES AND MEASUREMENT C-08953, G-05942, G-05949, G-06323, K-05947, K-11734, L-03198
BLACK LIQUOR OXIDATION A-00525, A-04879, A-04893, A-06981, A-08359, A-11144, A-12507, A-12621, A-17603, A-24903, A-32879, B-00025, B-01505, B-01672, B-01900, B-04045, B-04773, B-04781, B-04861, B-04882, B-04950, B-04951, B-05332, B-05880, B-06106, B-06859, B-07434, B-08360, B-08361, B-08364, B-09655, B-09656, B-09933, B-10994, B-11008, B-11009, B-11153, B-11158, B-11673, B-12658, B-13334, B-13398, B-13772, B-14094, B-14113, B-15709, B-15779, B-16747, B-16807, B-16842, B-17409, B-18140, B-21051, B-22061, B-22400, B-23117, B-23538, B-23901, B-24079, B-25950, B-26172, B-26173, B-26176, B-27357, B-29278, B-30062, B-30339, B-31072, B-31463, B-31794, B-32615, B-32798, B-32937, B-34385, B-35660, B-35803, C-00965, C-08354, C-34863, D-00209, D-07572, D-09592, D-16062, F-01784, F-16828, J-16457, L-06732
BLAST FURNACES A-25638, A-26402, A-26574, B-31223, L-01528, L-09677
BLENDING B-32956
BLOOD CELLS A-31759
BLOOD CHEMISTRY G-05949
BLOOD GAS ANALYSIS N-20495
BLOOD PRESSURE G-21712
BLOOD VESSELS K-30870
BLOWBY A-28352, A-34766, B-00504
BODY CONSTITUENTS AND PARTS A-07561, B-03297, B-06280, B-09854, C-08066, C-08678, F-03173, F-11132, G-00177, G-05942, G-05946, G-05949, G-06323, G-07821, G-09659, G-11476, H-00252, K-11734, M-00376, N-05235
BODY FLUIDS B-09854
BODY PROCESSES AND FUNCTIONS A-03825, A-04785, A-07089, B-02427, B-02729, B-04627, B-04666, B-04669, B-05532, B-08104, B-09854, B-09922, B-10005, C-06381, C-08066, C-08678, C-08953, C-09364, C-09521, C-09648, C-10983, C-11123, D-00209, D-00373, D-02339, F-11132, G-00177, G-03788, G-05942, G-05946, G-05949, G-06323, G-07091, G-07821, G-09659, G-11476, K-05947, K-11734, L-03198, N-05235
BOILERS A-09175, A-10075, A-11969, A-17633, A-25205, A-25638, A-26605, A-30218, A-32475, A-32879, A-34290, B-07971, B-09656, B-09661, B-09784, B-09933, B-12658, B-14094, B-15709, B-16747, B-17635, B-19218, B-20824, B-22522, B-23117, B-25085, B-26002, B-26176, B-28108, B-31091, B-31233, B-31453, B-31456, B-31463, B-32497, B-34679, B-35803, C-23106, C-35956, D-09592, D-29973, E-26550, K-31968, L-04942, L-09604, L-09677, L-30149, L-32626, M-08698
BONES B-09854, K-31968
BREATHING B-08104, B-34778, C-08678, C-09648, D-00373, D-02339, G-05946, K-05947
BREATHING EXERCISES G-05942
BRICKS B-09830, B-10277, B-32302
BROMIDES B-14692
BROMINATED HYDROCARBONS C-05813, C-10983
BROMINE A-34018, C-04883, C-11123, C-29269
BROMINE COMPOUNDS B-00975, B-14692
BRONCHI G-07821
BRONCHITIS A-22973, B-25479, D-33108, G-07821, G-27137, L-03198, L-14616
BROWNIAN MOVEMENT A-33828
BUBBLE TOWERS B-00358, B-03966, B-04627
BUDGETS L-25446, L-28348, L-32147, L-34755, M-31071
BUILDINGS A-33713, B-08104, B-09784, B-11843, B-31233, B-32797, C-10029, C-13627, D-09590, G-05942, I-05463
BUSES A-05007, A-05549, A-05608, A-06039, A-27129, A-30851, A-34018, B-00975, B-01867, B-05490, B-06280, B-06453, B-07224, B-07479, B-07971, B-08604, B-09608, B-11220, B-12133, B-20120, B-20877, B-20878, B-25594, C-22448, K-00157, L-00054, L-04841, L-04888
BUTADIENES A-32475, D-00251, D-23149, K-21083
BUTANES B-32956
BUTENES B-06636, D-00251
BUTYRALDEHYDES D-29349
BY-PRODUCT RECOVERY A-06981, A-08359, A-10699, A-12083, A-17603, A-22860, A-26402, A-30389, A-35599, B-00025, B-00504, B-01672, B-01900, B-02018, B-04045, B-04773, B-06412, B-08360, B-08364, B-09508, B-09655, B-09733, B-09813, B-09922, B-09933, B-10994, B-11153, B-12658, B-13551, B-13772, B-14118, B-14203, B-14609, B-14940, B-15690, B-15779, B-21647, B-23002, B-24079, B-24969, B-25977, B-26172, B-26308, B-26618, B-27719, B-30339, B-30530, B-31167, B-31790, B-32497, B-32847, B-32900, B-32935, B-32956, B-33073, B-34385, C-08354, D-07572, J-16457, N-19060

C

CADMIUM COMPOUNDS A-30513, C-08356, C-08358, C-09619, K-31968, L-27677
CALCIUM COMPOUNDS A-25205, B-11009, B-11234, B-14671, B-20369, B-28146, B-29251, B-30350, B-31790, B-32646, B-34073, F-11132, I-05463
CALIBRATION METHODS C-08357, C-08358, C-09521, C-10016, C-10693, D-29349, M-23408
CALIFORNIA A-03097, A-06981, A-24527, A-32653, A-35693, B-00504, B-00975, B-03297, B-06412, B-08663, B-09784, B-09842, B-14341, B-16890, B-26057, B-32559, C-03010, G-27137, K-00157, K-11734, K-35146, L-00549, L-00973, L-09677, L-34256, L-35694
CAMERAS C-17044
CANADA A-00393, A-02001, A-03097, A-12507, A-20134, A-24903, A-28352, A-34018, B-00257, B-00286, B-00379, B-00975, B-01867, B-02794, B-03976, B-05808, B-08364, B-13772, B-14113, B-15690, B-21220, B-22522, B-23901, B-26173, B-27357, B-29628, B-31794, C-00178, C-00965, C-02786, C-03010, C-03542, C-03789, C-34178, D-00251, F-13670, F-17801, F-32271, G-00177, G-00715, H-20028, L-03198, L-15688, L-25446, L-32352, M-24091, N-19060
CANCER A-22973, L-34256
CANNING A-09853, A-31602, A-35693, B-06412, B-21888, C-08066
CARBON BLACK A-34287, A-34290, B-00286, B-00358, B-07479, B-20369, B-22518, B-24969, B-26836, B-28047, B-30479, B-30530, B-31211, B-31233, B-31354, B-32070, B-32847, B-32900, B-33122, B-35609, G-00177, G-07091
CARBON DIOXIDE A-02001, A-05549, A-07561, A-08373, A-09175, A-10075, A-14297, A-20101, A-20276, A-25455, A-27249, A-27451, A-30603, A-32411, A-32489, A-34018, A-34891, A-35564, B-00975, B-01508, B-01867, B-03966, B-04361, B-08104, B-08497, B-09655, B-09827, B-20878, B-22838, B-24079, B-25554, B-27541, B-31091, B-31233, B-32119, B-33816, C-03010, C-03354, C-06112, C-07214, C-08354, C-19051, C-30704, C-32467, D-00241, D-00251, D-00373, D-23845, F-16828, G-00715, G-20969, I-05463, L-09677, L-29975, L-32147, L-32171, N-19060, N-20495
CARBON DISULFIDE B-04627, B-13072, C-03354, C-05426, C-08066, C-11123, C-14108, C-14109, C-29269, C-35865, D-16635, D-29349, G-05943
CARBON MONOXIDE A-01565, A-02001, A-05007, A-05549, A-06039, A-07561, A-08373, A-08802, A-09175, A-09255, A-12377, A-12998, A-14116, A-14297, A-16135, A-20101, A-20125, A-20134, A-22973, A-24459, A-26048, A-26911, A-27129, A-27249, A-27451, A-28352, A-30513, A-30603, A-31323, A-31759, A-31880, A-31882, A-32411, A-32465, A-32489, A-32653, A-32855, A-33648, A-33719, A-33828, A-34018, A-34891, A-35564, B-00504, B-00975, B-01867, B-03966, B-04361, B-04627, B-05808, B-06280, B-06636, B-07224, B-07362, B-07971, B-08497, B-08604, B-08663, B-09784, B-11234, B-17906, B-19493, B-20878, B-21220, B-24845, B-24969, B-24988, B-26944, B-27401, B-29437, B-29533, B-30738, B-30865, B-31062, B-31167, B-31233, B-31354, B-31400, B-32119, B-32559, B-32956, B-33077, C-03010, C-04117, C-06112, C-08354, C-09476, C-16298, C-19051, C-20100, C-27248, C-29337, C-29843, C-34279, C-35956, D-00241, D-00251, D-00373, D-01949, D-06535, D-09592, D-16636, D-23845, D-24162, D-25996, D-26304, D-27255, D-29973, D-33539, D-35764, F-16828, G-00177, G-00715, K-00157, K-16263, K-18294, K-31968, L-01604, L-02840, L-03198, L-07235, L-32147, L-34926, M-24091, N-19060, N-20495
CARBON TETRACHLORIDE B-04838, B-31233, C-08066, C-11123
CARBONATES B-14671, B-30350, B-31790, L-04888
CARBONYLS A-33564, A-33713, B-07531, C-07266, C-14109, C-16781, F-29649, L-04888, L-09677
CARBOXYHEMOGLOBIN A-30513, D-24162, L-03198
CARBURETION A-28352, B-07224, B-08663, B-09608, B-23067, B-25594, B-28108, B-31631
CARBURETOR EVAPORATION LOSSES A-01565, A-05007, A-28352, B-00504, B-17906, K-00157, K-16263, L-09677
CARCINOGENS A-01565, A-01644, A-01885, A-34766, B-00286, B-00504, B-00975, B-01414, B-01505, B-01563, B-02427, B-02729, B-03499, B-03966, B-04664, B-08663, C-00965, C-01289, D-00251, D-00690, D-01202, D-01949, D-02212, D-02339, D-03017, D-03506, D-03514, D-24162, F-03173, G-00177, G-03788, K-00157, L-00054, L-00973, L-01604, L-02840, M-00844, M-01069, N-03438
CARDIOVASCULAR DISEASES L-07235
CASCADE SAMPLERS A-28614, B-00975, B-33073, C-35956
CATALYSIS A-25179, A-32411, B-00358, B-01352, B-01414, B-01867, B-02427, B-02725, B-04300, B-04533, B-04669, B-05808, B-05929, B-07362, B-09791, B-09849, B-11136, B-11137, B-11234, B-12133, B-17395, B-20369, B-23008, B-26172, B-26908, B-27154, B-27674, B-28756, B-30943, B-31167, B-31400, B-32768, B-32913, B-33742, B-33816, C-24429, D-00373, F-23187, G-00177, L-35511
CATALYSTS A-32411, B-00358, B-01414, B-01867, B-02427, B-04669, B-05808, B-05929, B-07362, B-09791, B-09849, B-11136, B-11137, B-17395, B-20369, B-23008, B-26172, B-27154, B-27674, B-28756, B-31167, B-31400, B-32768, B-32913, B-33742, B-33816, C-24429, D-00373, G-00177, L-35511
CATALYTIC ACTIVITY B-04300, B-05808, B-05929, B-07362, B-11136, B-26908, B-30943, B-33742
CATALYTIC AFTERBURNERS A-06039, A-08912, A-25179, A-32465, A-34585, B-00504, B-00571, B-01414, B-01867, B-02047, B-02725, B-03499, B-04300, B-06453, B-06979, B-07362, B-07479, B-09508, B-09608, B-09791, B-11059, B-11136, B-11137, B-14341, B-14757, B-19493, B-20817, B-23067, B-23967, B-24988, B-25554, B-26308, B-27154, B-27401, B-30738, B-31167, B-31400, B-31631, C-24429, L-04888
CATALYTIC OXIDATION A-00525, A-04879, A-04893, A-06981, A-08359, A-11144, A-12507, A-12621, A-12998, A-17603, A-21887, A-23843, A-24754, A-24903, A-25179, A-32411, A-32879, A-33188, B-00025, B-00358, B-00379, B-00504, B-01505, B-01672, B-01900, B-02725, B-03966, B-04045, B-04300, B-04533, B-04669, B-04773, B-04781, B-04861, B-04882, B-04950, B-04951, B-05332, B-05808, B-05880, B-05929, B-06106, B-06859, B-07362, B-07434, B-07479, B-08360, B-08361, B-08364, B-09655, B-09656, B-09933, B-10005, B-10588, B-10994, B-11008, B-11009, B-11059, B-11153, B-11158, B-11673, B-12346, B-12482, B-12658, B-13334, B-13398, B-13551, B-13772, B-13812, B-14094, B-14113, B-14203, B-15709, B-15779, B-16498, B-16747, B-16807, B-16842, B-17395, B-17409, B-18050, B-18140, B-20628, B-20824, B-20877, B-20878, B-21051, B-21220, B-21702, B-22061, B-22357, B-22400, B-23008, B-23117, B-23538, B-23901, B-24079, B-24380, B-24969, B-25224, B-25554, B-25950, B-26128, B-26172, B-26173, B-26176, B-26308, B-26843, B-27154, B-27357, B-27401, B-27605, B-27674, B-28206, B-28756, B-29278, B-29601, B-30062, B-30339, B-30530, B-30809, B-30943, B-31072, B-31463, B-31794, B-32070, B-32615, B-32634, B-32768, B-32798, B-32937, B-33120, B-33742, B-33816, B-34385, B-35660, B-35803, C-00965, C-08354, C-25065, C-34863, D-00209, D-00373, D-07572, D-09592, D-16062, F-01784, F-16828, G-00177, J-16457, L-06732, L-32796, L-35511
CATS G-07821
CATTLE A-00402, A-22973, A-33828, B-03297, B-25858, C-28141, K-31968
CELLS A-31759, F-11132
CEMENTS A-32465, A-33719, A-34018, B-03976, B-07875, B-08467, B-09784, I-05463, K-31516
CENTRIFUGAL SEPARATORS A-07394, A-08912, A-09175, A-09853, A-17462, A-25056, A-29353, A-33188, B-04783, B-05332, B-05930, B-07429, B-09813, B-09849, B-09852, B-12434, B-12482, B-13697, B-14687, B-19850, B-20817, B-22353, B-22357, B-26568, B-27288, B-31301, B-31456, B-32634, C-27791, C-35956, D-02212, L-04942
CERAMICS B-07362, B-09830, B-09840
CESIUM COMPOUNDS B-11234, F-11132
CHARCOAL A-03825, A-04860, A-09853, A-32411, B-02427, B-04666, B-04669, B-04943, B-06103, B-08104, B-09854, B-10005, B-10588, B-11059, B-13072, B-16113, B-27818, B-29323, C-08678, D-00373, I-05463, L-14028
CHEMICAL BONDS A-28527, C-12492, C-33349, E-22335, F-17801, F-19061, F-24531
CHEMICAL COMPOSITION A-07089, A-11692, A-12505, A-14580, A-14914, A-17236, A-17631, A-25455, A-29842, A-30851, A-32653, A-33564, A-35590, A-35635, B-04533, B-05409, B-09608, B-09827, B-24380, B-31400, B-32119, B-32900, C-02786, C-03542, C-05170, C-10029, C-10534, C-12492, C-13099, C-13749, C-15287, C-29269, C-32467, C-32880, D-00251, D-18231, D-23845, F-12449, I-19325, L-00054, L-32893, L-34926

CHEMICAL METHODS A-05608, A-08802, A-10075, A-14580, A-17603, A-17631, A-21661, A-31602, A-33564, A-34287, A-34891, B-00032, B-00358, B-00379, B-02279, B-03807, B-03966, B-04045, B-04887, B-05408, B-05409, B-06453, B-06979, B-08364, B-08506, B-20628, B-23319, C-03010, C-04883, C-05426, C-08066, C-08354, C-08355, C-08358, C-09619, C-09657, C-10534, C-23755, C-27248, C-30014, C-32022, C-34279, C-35865, C-35956, D-00209, D-05481, F-01784, G-21359

CHEMICAL PROCESSING A-00525, A-01885, A-02765, A-04785, A-04879, A-04893, A-06240, A-06981, A-08359, A-11144, A-12507, A-12621, A-12832, A-12834, A-14580, A-16494, A-17603, A-17633, A-17634, A-19899, A-20553, A-22973, A-24350, A-24500, A-24527, A-24903, A-25179, A-25205, A-28295, A-28885, A-29599, A-29698, A-29842, A-30513, A-30687, A-30701, A-31044, A-31263, A-31602, A-31880, A-31882, A-32465, A-32475, A-32879, A-33883, A-33983, A-35581, B-00025, B-00032, B-00358, B-00552, B-00571, B-00975, B-01537, P-01549, B-01563, B-01672, B-01900, B-02018, B-02047, B-02279, B-02729, B-03129, B-03807, B-03946, B-03966, B-04045, B-04300, B-04773, B-04781, B-04783, B-04861, B-04882, B-04887, B-04943, B-04950, B-04951, B-04952, B-04953, B-05332, B-05408, B-05409, B-05808, B-05862, B-05880, B-05930, B-06105, B-06106, B-06859, B-07362, B-07415, B-07434, B-08360, B-08361, B-08364, B-08467, B-08946, B-09508, B-09655, B-09656, B-09661, B-09733, B-09784, B-09794, B-09836, B-09839, B-09840, B-09842, B-09849, B-09857, B-09922, B-09933, B-10277, B-10994, B-11008, B-11009, B-11153, B-11158, B-11673, B-12480, B-12482, B-12506, B-12658, B-13072, B-13334, B-13398, B-13551, B-13772, B-14094, B-14113, B-14118, B-14940, B-15170, B-15690, B-15709, B-15779, B-16747, B-16807, B-16842, B-17177, B-17266, B-17293, B-17409, B-17635, B-18140, B-19218, B-19493, B-19850, B-20258, B-20824, B-21051, B-22061, B-22353, B-22357, B-22435, B-22518, B-22522, B-22988, B-23117, B-23371, B-23538, B-23901, B-23967, B-24079, B-24743, B-25479, B-25950, B-25977, B-26128, B-26172, B-26173, B-26176, B-26254, B-26567, B-26618, B-26843, B-26908, B-27288, B-27357, B-27719, B-28118, B-29278, B-29363, B-29628, B-29745, B-30062, B-30339, B-30773, B-30943, B-31072, B-31167, B-31178, B-31223, B-31463, B-31790, B-31794, B-32497, B-32615, B-32681, B-32798, B-32900, B-32937, B-32956, B-33073, B-34385, B-34868, B-35595, B-35609, B-35660, B-35803, C-00965, C-01289, C-03789, C-04883, C-05614, C-06526, C-07214, C-08354, C-08355, C-08356, C-08357, C-08358, C-09648, C-09657, C-09660, C-15287, C-20460, C-21859, C-22431, C-22958, C-23106, C-25466, C-26966, C-27355, C-29726, C-31924, C-32467, C-32880, C-34047, C-34863, C-35949, C-35956, D-00209, D-00690, D-00751, D-02331, D-02339, D-03017, D-03506, D-06535, D-07572, D-09590, D-09592, D-16062, D-16635, D-23098, D-25780, D-31371, D-33108, D-33723, F-01784, F-10308, F-12662, F-16828, F-25761, G-00208, G-00715, G-03788, G-05942, G-21125, G-34667, I-24187, J-16457, K-20194, K-31516, L-00054, L-00871, L-03540, L-04942, L-06732, L-07235, L-14798, L-22343, L-27184, L-27185, L-29813, L-30149, L-31465, L-32796, L-32893, L-34033, M-00844, M-08698, M-13980, M-14491, M-15760, M-27680, M-30896

CHEMICAL REACTIONS A-04879, A-04893, A-05007, A-06981, A-08359, A-16135, A-25179, A-27451, A-28885, A-30513, A-31759, A-32411, A-33828, A-33983, A-34654, A-34766, A-35581, B-00257, B-00358, B-00379, B-00504, B-01505, B-01508, B-01900, B-02279, B-03499, B-03807, B-03972, B-04045, B-04838, B-04861, B-04882, B-04887, B-04950, B-04951, B-04952, B-04953, B-05532, B-05624, B-05808, B-05929, B-06106, B-06363, B-06636, B-06859, B-06979, B-07362, B-07479, B-08360, B-08361, B-08364, B-09661, B-09830, B-09836, B-09839, B-09849, B-09933, B-10005, B-10994, B-11008, B-11009, B-11673, B-12506, B-14203, B-15772, B-15948, B-17293, B-19850, B-20258, B-20625, B-20824, B-22400, B-22525, B-23117, B-23456, B-24079, B-25085, B-25379, B-25977, B-26014, B-26128, B-26176, B-26730, B-26731, B-26843, B-29131, B-29978, B-30738, B-31794, B-32559, B-32615, B-32634, B-32768, B-32935, B-32956, B-33077, B-33120, B-33122, B-35566, C-08354, C-08953, C-13099, C-14607, C-25065, C-31924, C-34279, C-35182, D-24162, E-19849, E-22335, F-07681, F-10308, F-16828, F-22430, F-23187, F-29649, G-00177, G-07821, K-11734, K-16263, L-03198, L-04888, L-32796

CHEMISTS L-14616

CHICAGO A-07394, A-08912, C-35541, L-00973, L-09677, L-30149

CHILDREN D-33108, K-11734

CHLORIDES A-17634, A-30687, A-32475, A-32489, B-04887, B-09839, B-09849, B-14692, B-20824, B-26843, C-08066, C-31222, C-32467, D-03514, D-23845, D-31760, D-33108, F-26529

CHLORINATED HYDROCARBONS A-17634, A-32475, B-04838, B-21294, B-28756, B-31233, B-32119, C-08066, C-11123, C-18093, D-00251, F-19102, K-21083, K-30870, L-14028

CHLORINE A-34018, B-00379, B-00552, B-03129, B-03807, B-04861, B-04887, B-06636, B-09729, B-09839, B-18169, B-25623, B-26176, B-30350, B-32646, C-03010, C-09657, C-11123, C-23107, C-29843, D-31371, D-33108, F-10308, G-05946, G-07091, K-31968

CHLORINE COMPOUNDS A-11651, A-17634, A-25228, A-30687, A-32475, A-32489, B-00379, B-00975, B-04666, B-04773, B-04861, B-04887, B-08360, B-09729, B-09839, B-09849, B-14692, B-16535, B-20824, B-26843, B-31794, B-32646, B-32781, B-32935, C-08066, C-31222, C-32467, C-35956, D-03514, D-23845, D-31760, D-33108, F-10308, F-26529, G-11476, J-16457, K-35146, L-27677, N-32254

CHLOROFORM B-31233, D-00251, F-19102

CHROMATOGRAPHY A-01644, A-03825, A-05549, A-06981, A-08373, A-15297, A-16494, A-17633, A-19814, A-20101, A-20557, A-21978, A-23843, A-25228, A-25327, A-25455, A-28527, A-29698, A-30687, A-30701, A-31044, A-31263, A-32411, A-32475, A-33564, A-33713, A-34766, A-34964, A-35581, B-00032, B-00286, B-00379, B-00571, B-02279, B-03966, B-04882, B-05408, B-05409, B-05808, B-06525, B-06979, B-09830, B-12480, B-14692, B-16842, B-17636, B-23371, B-24380, B-32099, B-32166, B-32302, B-34679, C-01289, C-02786, C-03010, C-03542, C-04883, C-05426, C-06112, C-06526, C-07214, C-08066, C-08354, C-08355, C-08356, C-08357, C-08358, C-09521, C-09619, C-09620, C-09657, C-10016, C-10029, C-10534, C-10593, C-10693, C-12488, C-12942, C-13099, C-13143, C-13367, C-13749, C-13969, C-14197, C-14680, C-15287, C-16134, C-16442, C-17288, C-17627, C-17628, C-17629, C-19051, C-20100, C-20192, C-20202, C-20264, C-20460, C-20624, C-21859, C-22431, C-23004, C-24814, C-26547, C-27121, C-27248, C-27355, C-27475, C-27685, C-27791, C-28141, C-28787, C-29337, C-29726, C-29843, C-30014, C-30374, C-30704, C-31222, C-31924, C-32022, C-32467, C-32795, C-32880, C-34279, C-34863, C-35541, C-35648, C-35751, C-35865, C-35949, C-35956, D-00209, D-00251, D-23098, D-29349, D-31371, F-01784, F-10308, F-13670, F-19061, F-19063, G-00177, G-03788, K-31286, L-35752

CHROMIUM B-07362, I-24187

CHROMIUM COMPOUNDS B-27401, D-29973

CHROMIUM OXIDES A-32855

CHRONIC G-07821, G-35671

CHRYSENES B-02725, D-00251

CINCINNATI A-05608, C-00178, D-23845, L-00973, L-09677

CINDERS A-34228, A-34290, B-27674, J-16457, L-07781, L-30149

CIRCULATORY SYSTEM A-17603, G-35671, H-00252, K-30870

CITIZENS GROUPS B-00975, L-27184, M-08698

CITRUS B-04943

CITY GOVERNMENTS A-08912, A-32855, B-07971, B-25479, D-01949, D-29973, L-00054, L-00549, L-14616, L-14932, L-19059, L-27184, L-27185, L-29679, L-30153, L-33117, L-33725

CLAY B-32302

CLEAN AIR ACT B-01672, L-00549, L-23754, L-33672, L-34033, M-08698

CLOUDS D-09592

COAL A-02765, A-23314, A-34018, B-01672, B-06636, B-07971, D-01949, D-03431, D-03506, D-03514, D-09590, D-09592, D-16636, D-23411, D-33108, K-07766, L-00054, L-00973, L-02840, L-07235, L-32626, N-32254

COAL CHARACTERISTICS B-06636

COAL PREPARATION B-09839, B-17266, B-33854, K-07766

COAL TARS B-02725, B-05929, B-09819, B-24065

COBALT COMPOUNDS F-11132

CODES B-26057, G-06323, L-32626

COFFEE-MAKING A-07394, A-08912, A-21887, A-24754, B-00246, B-01414, B-07362, B-09791, B-09852, B-26254, C-03354, C-05614
COKE A-33719, B-02725, B-29628, B-31223, D-33108, L-09677
COLLECTORS A-07394, A-08912, A-09175, A-09853, A-12621, A-17462, A-25056, A-29332, A-29353, A-33188, A-34228, B-04664, B-04783, B-05332, B-05852, B-05930, B-07429, B-07875, B-08360, B-09784, B-09813, B-09836, B-09849, B-09852, B-10009, B-12434, B-12482, B-13697, B-14687, B-19218, B-19850, B-20754, B-20817, B-21006, B-22353, B-22357, B-23594, B-25017, B-26568, B-27288, B-28146, B-29533, B-30530, B-31301, B-31456, B-31945, B-32634, B-35554, B-35660, C-03010, C-25065, C-27791, C-35956, D-02212, G-06323, J-34518, K-31968, L-04942, L-29813, L-32352, M-31071
COLLOIDS B-10588
COLORADO L-32147
COLORIMETRY A-05549, A-23843, A-35635, B-02279, B-03966, B-04045, B-06525, B-08364, C-02786, C-03010, C-03542, C-05426, C-06112, C-09619, C-09657, C-17288, C-23107, C-27248, C-27733, C-29337, C-30014, C-33577, C-35956, D-00209, D-05481, I-05463, K-27403, L-00054
COLUMN CHROMATOGRAPHY A-15297, A-20557, A-33564, A-34964, B-00379, B-03966, B-05408, B-05409, C-02786, C-10534, C-14680, C-27121, D-00251, F-01784, F-19063
COMBUSTION A-02001, A-03097, A-06981, A-08359, A-10075, A-10699, A-12377, A-20553, A-24007, A-24754, A-25056, A-25179, A-26048, A-27235, A-27249, A-28861, A-31602, A-32385, A-34654, A-34766, A-35383, A-35622, B-00257, B-00358, B-01352, B-01508, B-02427, B-02725, B-03499, B-04300, B-04361, B-04533, B-04669, B-04773, B-04861, B-05852, B-06088, B-06280, B-07224, B-07362, B-07971, B-08360, B-08663, B-09656, B-09791, B-09827, B-09830, B-09852, B-10009, B-11234, B-17293, B-17395, B-22538, B-23117, B-23456, B-23836, B-24743, B-25085, B-25379, B-25977, B-26002, B-26128, B-26567, B-26568, B-26730, B-26731, B-27154, B-27288, B-28756, B-29601, B-29745, B-31631, B-31911, B-33120, B-34385, B-35566, C-03010, C-08354, C-25065, C-31924, D-02331, D-09590, F-16828, L-02840, L-09677, N-20495
COMBUSTION AIR A-07561, A-10075, A-10699, A-24007, A-26911, A-27249, A-27986, A-28861, A-30603, A-34290, A-34654, B-04361, B-04781, B-04783, B-04838, B-05852, B-08360, B-09656, B-09827, B-09830, B-10009, B-11153, B-23836, B-25554, B-26731, B-27541, B-31091, B-32119, B-32302, B-32498, B-32937, B-33077, B-35566, B-35803, D-09592, I-19325
COMBUSTION GASES A-02001, A-07561, A-08359, A-08802, A-09175, A-10075, A-17631, A-17634, A-20118, A-22860, A-24007, A-25179, A-25205, A-26402, A-26574, A-26575, A-26605, A-27235, A-28527, A-28614, A-28861, A-29353, A-30218, A-30687, A-31155, A-31157, A-32465, A-32489, A-32879, A-33719, A-33883, A-33983, A-34290, A-35638, B-00246, B-00358, B-01505, B-01672, B-01900, B-03807, B-04227, B-04361, B-04533, B-04773, B-05332, B-05532, B-05930, B-06412, B-06636, B-06859, B-07971, B-08360, B-08497, B-08604, B-09655, B-09656, B-09784, B-09791, B-09813, B-09827, B-09830, B-10009, B-10277, B-10994, B-11009, B-11153, B-11158, B-13551, B-13772, B-13971, B-14004, B-14094, B-14203, B-14609, B-14687, B-14692, B-14895, B-14956, B-15690, B-15779, B-16747, B-17314, B-17403, B-19218, B-19363, B-19850, B-20817, B-20824, B-21647, B-21702, B-22061, B-22353, B-22400, B-22522, B-22525, B-23836, B-23967, B-25017, B-25085, B-25950, B-26173, B-26176, B-26568, B-26618, B-26731, B-27541, B-27548, B-27674, B-27732, B-27793, B-28146, B-28206, B-28756, B-29251, B-29363, B-29533, B-29628, B-29761, B-30062, B-30260, B-30350, B-30773, B-31091, B-31167, B-31223, B-31301, B-31354, B-31453, B-31456, B-31463, B-31631, B-31700, B-31790, B-31911, B-31945, B-32070, B-32119, B-32615, B-32634, B-32781, B-32847, B-32900, B-32913, B-32956, B-33077, B-34385, B-35554, B-35566, B-35803, C-01289, C-03010, C-04117, C-04883, C-05898, C-06112, C-08354, C-08355, C-08356, C-08357, C-09476, C-09648, C-09657, C-09660, C-19051, C-22958, C-23107, C-29243, C-32022, C-34863, C-35956, D-00209, D-01949, D-03459, D-03506, D-03514, D-07572, D-09592, D-16062, D-29973, D-33723, E-26550, F-10308, F-25761, G-00715, I-19325, J-16457, K-15926, K-31516, L-01528, L-04942, L-07235, L-07781, L-09677, L-10567, L-14798, L-15554, L-15691, L-27184, L-27185, L-27678, L-27679, L-28348, L-29679, L-29813, L-29975, L-30149, L-31084, L-32626, L-33672, L-35511, N-19060, N-19088
COMBUSTION PRODUCTS A-02001, A-05549, A-06981, A-07561, A-08359, A-08802, A-09175, A-09255, A-10075, A-16058, A-17631, A-17634, A-20118, A-22860, A-23313, A-23314, A-24007, A-25179, A-25205, A-26402, A-26574, A-26575, A-26605, A-27235, A-28527, A-28614, A-28861, A-29353, A-30218, A-30687, A-31155, A-31157, A-32465, A-32489, A-32879, A-33188, A-33719, A-33883, A-33983, A-34228, A-34290, A-35638, B-00025, B-00246, B-00358, B-00975, B-01505, B-01672, B-01900, B-03807, B-04227, B-04361, B-04533, B-04773, B-05332, B-05532, B-05930, B-06412, B-06636, B-06859, B-07971, B-08360, B-08497, B-08604, B-09655, B-09656, B-09784, B-09791, B-09813, B-09827, B-09830, B-10009, B-10277, B-10994, B-11008, B-11009, B-11153, B-11158, B-12434, B-13551, B-13772, B-13971, B-14004, B-14094, B-14203, B-14609, B-14687, B-14692, B-14895, B-14956, B-15690, B-15779, B-16747, B-17314, B-17403, B-19218, B-19363, B-19850, B-20258, B-20817, B-20824, B-21647, B-21702, B-22061, B-22353, B-22400, B-22522, B-22525, B-23836, B-23967, B-24969, B-25017, B-25085, B-25950, B-26173, B-26176, B-26568, B-26618, B-26731, B-27541, B-27548, B-27674, B-27732, B-27793, B-28146, B-28206, B-28756, B-29251, B-29363, B-29533, B-29628, B-29761, B-30062, B-30260, B-30350, B-30773, B-31091, B-31167, B-31223, B-31301, B-31354, B-31453, B-31456, B-31463, B-31631, B-31700, B-31790, B-31911, B-31945, B-32070, B-32119, B-32615, B-32634, B-32681, B-32781, B-32847, B-32900, B-32913, B-32956, B-33077, B-33793, B-34385, B-35554, B-35566, B-35803, C-01289, C-03010, C-04117, C-04883, C-05898, C-06112, C-08354, C-08355, C-08356, C-08357, C-09476, C-09619, C-09648, C-09657, C-09660, C-19051, C-22958, C-23107, C-29243, C-32022, C-34863, C-35956, D-00209, D-01949, D-03459, D-03506, D-03514, D-07572, D-09590, D-09592, D-16062, D-23411, D-29973, D-33723, E-26550, F-10308, F-25761, G-00715, I-19325, J-16457, K-11734, K-15926, K-31516, L-01528, L-04942, L-07235, L-07781, L-09604, L-09677, L-10567, L-14798, L-15554, L-15691, L-27184, L-27185, L-27678, L-27679, L-28348, L-29679, L-29813, L-29975, L-30149, L-31084, L-32171, L-32626, L-33672, L-35511, N-19060, N-19088
COMMERCIAL AREAS D-09590, L-00054, L-07235, L-09677, L-10567, L-32352
COMMERCIAL EQUIPMENT A-29332, B-00246, B-00541, B-00552, B-00975, B-01549, B-05862, B-09791, B-09840, B-26128, B-30260, C-02786
COMMERCIAL FIRMS B-06103, B-26128, B-29761, B-30260, C-04117, C-08678, D-16062, D-29973, L-14932, L-23754, L-29813, L-29975, M-31071
COMMON COLD C-08678
COMPLAINTS A-14972, A-27669, A-28295, A-30687, A-30851, A-31263, A-32855, B-00032, B-00975, B-01352, B-05862, B-08360, B-24380, B-25479, B-29761, B-33077, C-00178, C-05614, C-05898, C-08678, C-09660, D-01202, D-02339, D-03017, D-03431, D-17630, D-23149, D-23152, D-29973, D-33539, G-00208, G-28175, L-00054, L-00871, L-01604, L-10484, L-23754, L-26940, L-27184, L-27185, L-30153, L-30688, L-32352, L-32796, M-08698, M-13980, M-15760, M-30896
COMPOSTING A-11651, A-17236, A-29353, A-35599
COMPRESSED GASES A-21395, B-09836, B-27719, C-32467
COMPRESSION B-07362, B-09836, B-26125
COMPUTER PROGRAMS C-08268, D-33539, F-14987, F-33084
COMPUTERS C-17044, C-32268, D-33539, L-35511
CONCRETE B-09784, B-09836, B-10277, D-09592, I-05463
CONDENSATION A-04860, A-08359, A-09853, A-24527, B-01352, B-01505, B-01672, B-05408, B-05532, B-06103, B-09656, B-09661, B-09794, B-09813, B-09836, B-09852, B-09854, B-11059, B-15779, B-20824, B-25085, B-26014, B-27288, B-29745, B-30339, B-31091, C-25065, C-32467, C-35956

CONDENSATION (ATMOSPHERIC) A-35622, B-02047, B-16842, D-09592, L-14616, L-34926, M-00376, M-26725

CONSTRUCTION MATERIALS A-10699, A-32465, A-33719, A-34018, B-00975, B-03972, B-03976, B-04627, B-07875, B-08467, B-09784, B-09791, B-09819, B-09830, B-09836, B-09840, B-10277, B-24090, B-26125, B-32302, C-11486, D-03431, D-09590, D-09592, I-05463, I-24187, K-15926, K-31516, L-09677, L-15554, M-26725

CONTACT PROCESSING D-09592

CONTINUOUS MONITORING A-26605, A-29599, A-31155, B-10009, B-27793, B-28118, B-32798, C-05426, C-06112, C-19051, C-23107, C-27248, C-32022, C-34279, C-35956, D-00690, D-25291, G-00177, K-31286, L-01604, L-07235, L-25446

CONTRACTING L-27184

CONTROL AGENCIES A-24350, A-25638, B-25479, B-30260, C-03010, C-08678, C-32022, D-01949, D-03001, D-16062, D-23152, K-31968, L-07781, L-14616, L-19059, L-26940, L-28348, L-29679, L-30153, L-32171, L-32383, L-32626, L-33117, L-33672, L-34256, L-34755, L-35511, L-35752, M-08698, N-01539

CONTROL EQUIPMENT A-00525, A-04785, A-04860, A-06039, A-07394, A-08912, A-09175, A-09853, A-10699, A-11651, A-11969, A-12621, A-12998, A-17462, A-17603, A-17634, A-19366, A-20134, A-20276, A-21882, A-21887, A-22860, A-22987, A-24007, A-24527, A-24903, A-25056, A-25179, A-25205, A-25228, A-26402, A-27235, A-27972, A-28614, A-29332, A-29353, A-29599, A-30687, A-31155, A-31759, A-31880, A-32385, A-32465, A-32489, A-32879, A-33188, A-34228, A-34287, A-34585, A-35564, A-35581, A-35590, A-35599, A-35638, B-00025, B-00032, B-00257, B-00286, B-00358, B-00379, B-00504, B-00541, B-00552, B-00571, B-00975, B-01352, B-01414, B-01505, B-01537, B-01549, B-01672, B-01867, B-01900, B-02047, B-02279, B-02427, B-02488, B-02725, B-02729, B-03129, B-03499, B-03807, B-03966, B-03976, B-04045, B-04227, B-04300, B-04627, B-04664, B-04669, B-04773, B-04781, B-04783, B-04882, B-04943, B-04949, B-05332, B-05408, B-05624, B-05852, B-05862, B-05880, B-05929, B-05930, B-06088, B-06106, B-06280, B-06363, B-06366, B-06412, B-06453, B-06525, B-06688, B-06859, B-06979, B-07362, B-07374, B-07415, B-07429, B-07434, B-07479, B-07530, B-07531, B-07875, B-08104, B-08360, B-08364, B-08467, B-08946, B-09508, B-09608, B-09655, B-09656, B-09661, B-09733, B-09784, B-09791, B-09794, B-09813, B-09815, B-09819, B-09830, B-09836, B-09839, B-09840, B-09842, B-09849, B-09852, B-09854, B-09922, B-10005, B-10009, B-10277, B-10588, B-11008, B-11059, B-11136, B-11137, B-11158, B-12434, B-12482, B-12658, B-13334, B-13551, B-13697, B-13772, B-13971, B-14094, B-14118, B-14341, B-14354, B-14488, B-14671, B-14687, B-14757, B-14895, B-14940, B-14951, B-14956, B-15690, B-15709, B-15779, B-16113, B-16365, B-16712, B-16747, B-16807, B-16842, B-17177, B-17403, B-18140, B-18169, B-19218, B-19221, B-19363, B-19493, B-19705, B-19850, B-20709, B-20754, B-20817, B-20824, B-20877, B-20878, B-21006, B-21051, B-21647, B-21677, B-21702, B-21888, B-21938, B-22353, B-22357, B-22400, B-22435, B-22522, B-22525, B-23067, B-23117, B-23319, B-23371, B-23493, B-23594, B-23885, B-23901, B-23967, B-24065, B-24090, B-24380, B-24810, B-24969, B-24988, B-25017, B-25085, B-25479, B-25554, B-25694, B-25711, B-25977, B-26002, B-26014, B-26128, B-26173, B-26176, B-26254, B-26296, B-26308, B-26568, B-26843, B-26944, B-27154, B-27288, B-27336, B-27401, B-27732, B-27793, B-27818, B-28118, B-28146, B-29251, B-29261, B-29323, B-29363, B-29437, B-29533, B-29745, B-29761, B-30062, B-30124, B-30350, B-30479, B-30530, B-30738, B-30773, B-30782, B-30943, B-31062, B-31160, B-31167, B-31178, B-31211, B-31223, B-31233, B-31301, B-31302, B-31354, B-31400, B-31453, B-31456, B-31463, B-31472, B-31631, B-31790, B-31945, B-32057, B-32099, B-32166, B-32559, B-32615, B-32634, B-32646, B-32681, B-32682, B-32768, B-32781, B-32847, B-32900, B-32913, B-32935, B-32937, B-32956, B-33003, B-33077, B-33120, B-33122, B-33380, B-33617, B-33854, B-34385, B-34679, B-34778, B-35554, B-35595, B-35609, B-35660, B-35803, B-35955, C-00965, C-02786, C-03010, C-03789, C-04117, C-05614, C-05898, C-06112, C-09619, C-17288, C-17627, C-17628, C-17638, C-17641, C-20202, C-21859, C-23004, C-24429, C-25065, C-26547, C-27685, C-27791, C-29337, C-30704, C-31222, C-31924, C-34279, C-35956, D-00209, D-00373, D-02212, D-07572, D-09590, D-09592, D-20355, D-23845, G-00177, G-05942, G-06323, I-05463, I-19325, I-24187, J-16457, J-29299, J-34518, K-31968, L-04888, L-04942, L-07235, L-09604, L-10567, L-14028, L-14932, L-29813, L-29975, L-30149, L-31084, L-32352, L-35511, M-08698, M-31071, N-03438

CONTROL METHODS A-00393, A-00525, A-01565, A-02001, A-03825, A-04785, A-04860, A-04879, A-04893, A-05007, A-05335, A-05527, A-05549, A-06039, A-06981, A-07394, A-07561, A-08359, A-08802, A-08912, A-09255, A-09853, A-10075, A-10699, A-11144, A-11651, A-12083, A-12377, A-12505, A-12507, A-12621, A-12998, A-14297, A-14580, A-14914, A-17603, A-17632, A-17634, A-19366, A-19899, A-20116, A-20276, A-20553, A-21661, A-21700, A-21887, A-22860, A-22987, A-23000, A-23313, A-23314, A-23843, A-24007, A-24527, A-24754, A-24903, A-25056, A-25179, A-25205, A-25228, A-25455, A-25638, A-26048, A-26402, A-26575, A-26605, A-26826, A-26911, A-27129, A-27249, A-27821, A-27972, A-27986, A-28352, A-28861, A-29332, A-29455, A-29599, A-29842, A-30389, A-30603, A-30701, A-30851, A-31155, A-31157, A-31323, A-31602, A-31759, A-31880, A-31882, A-32385, A-32411, A-32653, A-32855, A-32879, A-33188, A-33883, A-34228, A-34290, A-34585, A-34654, A-34891, A-35383, A-35564, A-35581, A-35590, A-35599, A-35622, A-35673, B-00025, B-00032, B-00246, B-00257, B-00286, B-00358, B-00379, B-00504, B-00541, B-00552, B-00571, B-00975, B-01352, B-01414, B-01505, B-01508, B-01537, B-01549, B-01563, B-01613, B-01672, B-01867, B-01900, B-02018, B-02047, B-02427, B-02725, B-02729, B-03129, B-03297, B-03499, B-03807, B-03946, B-03966, B-03972, B-04045, B-04227, B-04300, B-04361, B-04533, B-04627, B-04664, B-04666, B-04669, B-04773, B-04781, B-04783, B-04838, B-04861, B-04882, B-04887, B-04943, B-04950, B-04951, B-04952, B-04953, B-05093, B-05332, B-05408, B-05409, B-05490, B-05532, B-05624, B-05808, B-05852, B-05862, B-05880, B-05929, B-05930, B-06088, B-06103, B-06106, B-06280, B-06363, B-06366, B-06412, B-06453, B-06525, B-06636, B-06859, B-06979, B-07224, B-07362, B-07374, B-07415, B-07429, B-07434, B-07479, B-07530, B-07531, B-07875, B-07971, B-08104, B-08360, B-08361, B-08364, B-08467, B-08497, B-08506, B-08604, B-08663, B-08946, B-09407, B-09508, B-09608, B-09655, B-09656, B-09661, B-09729, B-09733, B-09784, B-09791, B-09794, B-09813, B-09819, B-09827, B-09830, B-09836, B-09839, B-09840, B-09842, B-09849, B-09852, B-09854, B-09857, B-09922, B-09933, B-10005, B-10009, B-10588, B-10994, B-11008, B-11009, B-11059, B-11136, B-11137, B-11153, B-11158, B-11220, B-11234, B-11673, B-11843, B-12133, B-12346, B-12434, B-12480, B-12482, B-12506, B-12658, B-13072, B-13334, B-13398, B-13551, B-13772, B-13812, B-13971, B-14004, B-14013, B-14094, B-14113, B-14118, B-14203, B-14341, B-14354, B-14453, B-14488, B-14609, B-14671, B-14692, B-14757, B-14895, B-14940, B-14951, B-14956, B-15153, B-15170, B-15690, B-15709, B-15772, B-15779, B-15948, B-16113, B-16365, B-16498, B-16535, B-16712, B-16747, B-16807, B-16842, B-17177, B-17238, B-17266, B-17293, B-17314, B-17395, B-17403, B-17409, B-17635, B-17636, B-17637, B-17906, B-18050, B-18140, B-18153, B-18169, B-19182, B-19218, B-19221, B-19493, B-19705, B-19850, B-20120, B-20258, B-20369, B-20625, B-20628, B-20709, B-20754, B-20796, B-20817, B-20824, B-20877, B-20878, B-21006, B-21051, B-21220, B-21294, B-21647, B-21677, B-21702, B-21888, B-21938, B-22061, B-22353, B-22357, B-22400, B-22518, B-22522, B-22525, B-22538, B-22550, B-22837, B-22838, B-22988, B-23002, B-23008, B-23067, B-23117, B-23319, B-23371, B-23456, B-23493, B-23538, B-23594, B-23836, B-23885, B-23901, B-23967, B-24079, B-24380, B-24743, B-24810, B-24845, B-24969, B-24988, B-25017, B-25224, B-25379, B-25479, B-25554, B-25594, B-25623, B-25694, B-25711, B-25858, B-25950, B-25977, B-26002, B-26014, B-26056, B-26057, B-26087, B-26125, B-26128, B-26172, B-26173, B-26176, B-26254, B-26296, B-26308, B-26567, B-26568, B-26618, B-26730, B-26731, B-26836, B-26843, B-26908, B-27154, B-27288, B-27357, B-27401, B-27541, B-27548, B-27605, B-27674, B-27719, B-27732, B-27793, B-27818, B-28047, B-28108, B-28118, B-28206, B-28756, B-29131, B-29251, B-29278, B-29323, B-29363, B-29437, B-29448, B-29533, B-29601, B-29628, B-29745, B-29761, B-29877, B-29978, B-30062, B-30124, B-30260, B-30339, B-30350, B-30479, B-30530, B-30738, B-30782, B-30809, B-30865, B-30943, B-31062, B-31072, B-31091, B-31167, B-31178, B-31211, B-31233, B-31301, B-31302, B-31400, B-31453, B-31456, B-31463, B-31631, B-31700, B-31790, B-31794, B-31911, B-31945, B-32057, B-32070, B-32099, B-32119, B-32166, B-32302, B-32497, B-32498, B-32615, B-32634, B-32646, B-32681, B-32682, B-32768, B-32781, B-32797, B-32798, B-32799, B-32847, B-32900, B-32913, B-32935, B-32937, B-32956, B-33003, B-33073, B-33077, B-33120, B-33122, B-33380, B-33398, B-33617, B-33742, B-33793, B-33816, B-33854, B-34073, B-34385, B-34679, B-34778, B-34868, B-35554, B-35566, B-35595, B-35609, B-35660, B-35803, B-35879, B-35955, C-00965, C-03010, C-03542, C-04883, C-05170, C-05426, C-05614, C-05898, C-06112, C-08354, C-09619, C-09620, C-10016, C-10029, C-10534, C-10693, C-13749, C-17288, C-17639, C-17641, C-20460, C-20538, C-21208, C-24429, C-25054, C-25065, C-26966, C-27248, C-27475, C-29891, C-31924, C-32467, C-32676, C-34047, C-34863, C-35865, C-35956, D-00209, D-00373, D-02212, D-07572, D-09590, D-09592, D-16062, D-23149, D-33539, D-33723, D-35764, F-01784, F-10308, F-12662, F-14987, F-16828, F-26529, F-29649, G-00177, G-00208, G-00715, G-03788, G-07091, G-07821, G-34667, I-05463, I-19325, I-24187, J-16457, J-29299, K-00157, K-07766, K-18294, K-31516, L-00973, L-03198, L-03540, L-04888, L-06732, L-07235, L-09215, L-14028, L-14616, L-14932, L-16330, L-22343, L-28348, L-29679, L-29975, L-30149, L-31084, L-32796, L-33672, L-33725, L-34926, L-35511, L-35752, M-30896, N-05235, N-19060, N-19088, N-20495

CONTROL PROGRAMS A-02765, A-31323, A-32465, B-00504, B-00975, B-01505, B-01672, B-01867, B-03129, B-07971, B-25479, B-30865, B-32057, C-03010, D-02339, D-03017, D-03418, D-03459, D-05481, D-16062, D-25996, D-29973, D-31371, K-00157, K-11734, K-31968, L-00549, L-01604, L-02295, L-02840, L-03540, L-06732, L-09677, L-10567, L-15691, L-17258, L-19059, L-26940, L-27184, L-27185, L-29813, L-30688, L-32147, L-32352, L-32354, L-34256, L-34755, M-31071

CONTROLLED ATMOSPHERES A-03825, A-21978, B-00286, B-08104, B-14951, B-21006, B-34778, C-08268, C-09860, C-11123, C-21208, D-18231, G-00715, G-05946

COOLING A-07394, A-21395, A-26605, B-07531, B-09794, B-09842, B-10009, B-14094, B-24065, B-32781, B-34778, B-35554, C-08355, C-08356, C-08358, C-10534, C-35956

COPPER A-34287, B-07362, B-09830, C-08066

COPPER COMPOUNDS B-03499, B-09839, B-27401, I-05463

CORE OVENS A-25179, B-09784, B-09791, L-31084

CORONA B-06688, B-26296, B-30479

CORROSION A-16058, A-22973, A-34287, B-01505, B-02018, B-10277, B-19218, B-26172, B-29323, B-31790, D-03017, D-06535, D-09590, D-09592, I-19325, I-24187, L-01604

COSTS A-00402, A-17603, A-21395, A-22860, A-24903, A-25179, A-25205, A-26911, A-28352, A-29353, A-31882, A-32385, A-33883, A-34228, A-34290, A-35581, A-35693, B-00257, B-00552, B-01867, B-04300, B-05093, B-05930, B-06103, B-08946, B-09656, B-09791, B-09836, B-09922, B-09933, B-10009, B-10277, B-11137, B-11158, B-13551, B-13812, B-14687, B-14757, B-15709, B-16890, B-17314, B-19363, B-19850, B-20817, B-20824, B-21051, B-22518, B-22838, B-23967, B-24090, B-24197, B-26128, B-26778, B-27154, B-28047, B-29261, B-29323, B-29601, B-31453, B-31631, B-31700, B-31945, B-32099, B-32498, B-32935, B-35660, C-26966, C-32676, D-25996, J-16457, J-29299, J-34518, K-18294, L-04942, L-25446, L-30149, L-31084, L-35752, M-24091, M-31071

COTTON A-35564

COTTONS B-09813, B-09815, B-09830, L-01604

COUGH A-30687, G-28175, G-34686, M-14491

COUNTY GOVERNMENTS A-12832, A-12834, A-23313, A-23314, B-09784, C-03010, D-01949, D-23411, L-00549, L-07781, L-09677, L-32171, L-32382, L-32383

CRACKING A-17603, E-19849

CRANKCASE EMISSIONS A-01565, A-05007, A-28352, A-32465, A-34766, B-00504, B-17906, D-00241, D-00251, K-00157, K-16263, L-09677

CRANKCASE VENTILATION AIR K-16263

CRITERIA A-14116, A-19366, A-21395, A-25638, A-26911, A-35581, A-35638, B-09661, B-14341, B-14687, B-26087, B-29323, B-31062, B-32057, C-33121, D-00751, D-05256, D-09590, D-18231, G-06323, K-05117, K-07766, K-11734, K-31516, K-35146, L-00973, L-01604, L-09677, L-10484, L-15688, L-32352, L-32354, L-32566

CROP SPRAYING A-35564, B-32682, D-23411

CROPS A-34018, A-35564, D-09590, D-33108, K-11734, L-03198, N-03438

CRYSTAL STRUCTURE F-24354

CUMULATIVE METHODS C-05426, C-05503, D-03001, D-09590, D-25291, L-01604

CUPOLAS A-25638, A-28614, A-32489, C-03010, D-29973, L-01528, L-09677, L-29975, L-31084

CYANIDES A-12083, B-14692, C-24429

CYCLIC ALKANES D-00251

CZECHOSLOVAKIA A-03097, B-00257, B-00286, B-00379, B-00975, B-01867, B-02047, B-03976, C-00178, C-02786, C-03010, C-03354, C-03542, C-29243, D-00209, D-00251, D-00373, D-00751, D-03514, F-03173, G-00177, G-00715, M-00376, M-00487, M-00844

D

DATA ANALYSIS A-14972, C-09860, C-32268, M-00487

DATA HANDLING SYSTEMS A-14972, B-00975, C-08268, C-09860, C-32268, D-33539, F-14987, F-33084, M-00487

DECISIONS B-25479, L-35694

DECOMPOSITION A-08359, A-33983, B-04953, B-09830, B-09839, B-25085, B-33122, C-13099, F-29649

DEFOLIANTS B-00571

DEGREASING B-09784

DELAWARE B-02794, L-23754

DENSITY A-29599, A-30513, B-31301, B-32070, B-32302, B-32634, B-33073

DEPOSITION C-35956, D-29973

DESIGN CRITERIA A-02001, A-03825, A-10699, A-11969, A-14116, A-17462, A-20276, A-21700, A-22860, A-25056, A-26574, A-26575, A-27235, A-27972, A-28861, A-30327, A-31155, A-31157, A-34654, B-00552, B-00571, B-02725, B-02729, B-04838, B-05093, B-05929, B-06088, B-06103, B-08497, B-09733, B-09784, B-09791, B-09813, B-09827, B-09830, B-09836, B-09840, B-09842, B-09849, B-11009, B-11136, B-11137, B-12658, B-14609, B-16747, B-17177, B-18050, B-19221, B-20754, B-21006, B-21051, B-22353, B-22522, B-23836, B-24065, B-24090, B-24197, B-24810, B-25017, B-25379, B-25554, B-25694, B-25711, B-26002, B-26172, B-26296, B-26308, B-26568, B-26778, B-26944, B-27336, B-27357, B-27401, B-27541, B-27548, B-27793, B-27818, B-28146, B-28206, B-29251, B-30062, B-30479, B-30738, B-30773, B-30782, B-31091, B-31160, B-31456, B-31463, B-31790, B-31911, B-32070, B-32497, B-32498, B-32634, B-33073, B-33617, B-35554, B-35955, C-08356, C-09521, C-10593, C-12359, C-12487, C-17629, C-18194, C-24429, C-32676, C-32795, C-35956, D-07572, I-24187, L-04841

DESULFURIZATION OF FUELS A-31759, A-33883, B-06636, B-09839, B-17266, B-20369, B-26908, B-28118, B-32956, B-33854, D-33723, D-35764, K-07766, L-07235

DETERGENT MANUFACTURING B-07429, B-09784, B-09794, B-09849

DETROIT L-00973, L-09677

DIAGNOSIS C-29858, G-06323

DIESEL ENGINES A-00393, A-01565, A-05007, A-05335, A-05527, A-05549, A-05608, A-06039, A-08802, A-09255, A-11692, A-12377, A-12505, A-14116, A-14297, A-14914, A-15297, A-20101, A-20118, A-20553, A-20557, A-21700, A-25327, A-25455, A-26048, A-27129, A-27249, A-27986, A-28352, A-30603, A-30851, A-33564, A-33648, A-33719, A-34018, A-34766, A-34891, A-34964, A-35590, A-35635, B-00504, B-01613, B-01867, B-05490, B-06280, B-06453, B-06525, B-06636, B-06979, B-07479, B-07971, B-08497, B-08663, B-09608, B-11220, B-11234, B-12133, B-17906, B-20120, B-20877, B-20878, B-21220, B-23067, B-24845, B-24988, B-29437,

B-29533, B-31167, B-31400, B-31631, C-02786, C-03542, C-05170, C-07266, C-14606, C-14607, C-14680, C-16442, C-16781, C-20100, C-21693, C-22448, C-26966, C-27121, C-27934, C-29337, C-31924, D-00241, D-00251, D-18231, D-24162, G-34667, K-00157, K-16263, L-00054, L-03198, L-04841, L-04888, L-05129, L-09215, L-12376, L-35511, M-23408
DIFFRACTION B-34073
DIFFUSION A-33828, A-33883, A-35622, A-35693, B-01672, B-32900, C-00178, C-09648, C-10693, C-22958, C-25065, D-09590, D-17630, D-25780, D-33723, F-32271, G-06323, L-01604, L-22343, L-25446, L-34926
DIFFUSION MODELS A-33828, C-25065, G-06323, L-01604, L-25446, L-34926
DIGESTERS A-09853, A-32475, A-32879, B-04861, B-04951, B-07434, B-09508, B-09655, B-09656, B-09661, B-09839, B-11008, B-15709, B-16842, B-23117, B-25085, B-26176, B-27288, B-32615, B-32681, B-32798, B-34385, D-09592, L-30149
DIGESTIVE SYSTEM G-21712
DIOLEFINS A-05007, A-32475, D-00251, D-23149, K-21083
DIPHENYLS G-05949
DISCOLORATION A-16058, A-17603, C-08066, D-03017
DISPERSION A-03097, A-14972, A-16058, A-19814, A-28352, A-29353, A-29599, A-32489, A-32653, A-33828, A-33883, A-35622, A-35693, B-00975, B-01352, B-01672, B-04838, B-05490, B-07415, B-09608, B-10277, B-16712, B-19363, B-20796, B-23371, B-26087, B-31223, B-32900, C-00178, C-05396, C-05813, C-09648, C-10693, C-22958, C-25065, C-27248, C-35956, D-00690, D-02212, D-02339, D-03017, D-03431, D-03459, D-03506, D-09590, D-09592, D-12426, D-17630, D-23098, D-25780, D-33723, E-14906, E-26550, F-32271, G-03788, G-06323, L-01604, L-02840, L-04841, L-04888, L-14798, L-22343, L-25446, L-29813, L-34926, L-35511
DISPERSIONS B-05532, B-09839, B-10588, B-23493
DISSOCIATION B-04952, B-04953
DISTILLATE OILS A-09255, B-04361, B-09836, B-32956, D-01949, D-09592
DIURNAL A-32653, B-09836, B-31463, C-08678, C-25065, D-00690, D-01202, D-01949, D-03001, D-03017, D-03514, D-27255, D-29973, D-31371, D-33108, K-31516, K-35146, M-01069
DOMESTIC HEATING A-02001, A-10075, A-16058, A-31759, A-33719, B-04361, B-07971, B-25479, B-27541, B-28108, B-33854, D-00690, D-01949, D-03431, D-09590, D-09592, D-23411, D-29973, D-35764, K-31286, L-00054, L-07235, L-15688, L-32354, N-32254
DONORA L-10567
DROPLETS A-07394, B-02047, B-05532, B-06088, B-09819, B-09836, B-20817, B-24090, B-29533, B-32937, B-35955, C-35956, D-00373
DRUGS I-24187
DRY CLEANING A-34018, B-09784, B-11059, B-16113, D-03431, L-07235, L-14028, L-19059
DRY CLEANING SOLVENTS B-11059, B-16113, C-08066, L-07235, L-14028
DRYING A-09853, A-26605, A-29599, A-32879, A-34585, B-07530, B-07531, B-09813, B-09836, B-14453, B-25379, B-26568, B-28146, B-31167, B-32797, B-34385, B-34679, B-35879
DUMPS A-12832, A-12834, A-23313, A-23314, A-24350, A-35693, B-31453, D-02331, D-02339, D-23411, M-00844
DUST FALL A-12832, A-16135, A-35638, B-00975, B-10277, B-26087, D-02212, D-03017, D-05481, D-09590, D-23411, D-23845, D-26304, D-27255, D-31760, D-33723, K-07766, L-01604, L-07235, L-27184, M-01069, N-03438
DUSTS A-07394, A-08912, A-09175, A-09853, A-10699, A-12621, A-17633, A-20134, A-21882, A-24500, A-24903, A-25056, A-25205, A-25638, A-26574, A-26911, A-27669, A-29332, A-29353, A-30389, A-32385, A-32489, A-33188, A-33719, A-35564, B-00025, B-02279, B-04227, B-04949, B-05930, B-06859, B-07429, B-07875, B-08104, B-09407, B-09655, B-09733, B-09784, B-09813, B-09815, B-09849, B-09852, B-09854, B-10009, B-13551, B-13697, B-14094, B-14951, B-14956, B-16842, B-17403, B-19221, B-19363, B-20817, B-21006, B-21647, B-22357, B-23319, B-23493, B-24380, B-24810, B-26254, B-26296, B-26568, B-27288, B-29323, B-29363, B-29533, B-29761, B-30479, B-30530, B-31160, B-31233, B-31301, B-31354, B-31456, B-31472, B-31631, B-31945, B-32634, B-32682, B-32956, B-33120, B-35803, B-35955, C-03010, C-04117, C-21208, C-23107, D-02212, D-03431, D-03459, D-05481, D-09590, D-09592, D-12648, D-16636, D-23411, D-29973, D-33108, E-26550, K-07766, K-31968, L-01528, L-02840, L-04942, L-07235, L-07781, L-09677, L-15691, L-17258, L-19059, L-26511, L-27184, L-27185, L-27677, L-27678, L-27679, L-28363, L-29679, L-29813, L-29975, L-30149, L-31084, L-32171, L-32352, L-32383, L-32626, L-35511, M-00376
DYE MANUFACTURING B-09794, B-21294, I-05463, K-20194
DYNAMOMETERS A-33648, B-01867, B-05490, B-20878, D-00251, G-00177, L-04841

E

ECONOMIC LOSSES A-17603, A-22973, A-24350, A-26911, A-33828, A-34018, B-00975, B-01563, J-16457, L-01604
EDUCATION A-26911, L-05129, L-32147
ELECTRIC CHARGE B-05532, C-08953, C-35182, F-19061, G-20969
ELECTRIC FURNACES A-37489, D-29973
ELECTRIC POWER PRODUCTION A-12832, A-14972, A-24500, A-26911, A-30513, A-31759, A-31882, A-32653, A-33719, A-34018, B-00975, B-05880, B-07971, B-09784, B-10009, B-26087, B-28108, B-31400, C-31924, D-00373, D-03001, D-03431, D-09590, D-23411, D-25780, D-29973, D-33539, L-27184, L-27185, L-29679
ELECTRIC PROPULSION A-31759, L-35511
ELECTRICAL MEASUREMENT DEVICES C-12359, F-19102
ELECTRICAL PROPERTIES B-05532, B-06688, B-24065, B-25711, B-26296, B-28047, B-30479, B-32070, C-06526, C-08953, C-09619, C-35182, F-19061, F-19102, F-22430, G-20969, N-05235
ELECTRICAL RESISTANCE N-05235
ELECTROCHEMICAL METHODS B-00379, B-03966, B-04045, B-05408, B-08364, B-23319, C-04883, C-05426, C-08354, C-09619, C-23755, C-27248, C-30014, C-32022, C-34279, C-35956, F-01784, G-21359
ELECTROCONDUCTIVITY ANALYZERS B-32798, C-05426, C-06112, C-32022, C-34279, D-25291
ELECTROLYSIS B-22435, B-24743
ELECTRON MICROSCOPY A-00393, G-00177
ELECTROSTATIC COUNTERS B-04361, B-05532
ELECTROSTATIC PRECIPITATORS A-09175, A-17462, A-21882, A-22860, A-24903, A-25205, A-26402, A-29353, A-31759, A-33188, A-35564, B-02279, B-03976, B-04949, B-05880, B-07415, B-07875, B-08104, B-09655, B-09784, B-09819, B-09852, B-10277, B-11158, B-12658, B-13551, B-13697, B-14354, B-14687, B-15709, B-16842, B-17177, B-17403, B-19850, B-20817, B-20877, B-20878, B-22353, B-22357, B-22400, B-22522, B-23067, B-23371, B-23493, B-24065, B-24969, B-25711, B-26296, B-26568, B-27732, B-30479, B-31178, B-31453, B-31945, B-32615, B-32634, B-35660, B-35803, C-03010, C-03789, C-06112, C-35956, D-00373, D-09592, D-23845, J-16457, J-34518, L-04942, L-30149
ELUTRIATION B-17266
EMISSION INVENTORIES A-05549, A-05608, A-08912, A-22860, A-29599, A-30513, A-35638, B-00975, B-16842, C-27248, D-01202, D-02339, D-05481, D-06535, D-09590, D-09592, D-25780, D-25996, D-31760, D-33539, J-34518, L-01604, L-04942, L-32147
EMISSION STANDARDS A-21882, A-25205, A-25638, A-27821, A-29353, A-30603, A-31759, A-34290, A-34585, B-00504, B-03129, B-11059, B-24988, B-25479, B-31062, B-31301, C-09716, C-14680, C-25065, C-32022, D-18231, K-00157, K-07766, K-11734, K-15926, K-16263, K-18294, K-31516, K-35146, L-00973, L-03198, L-07781, L-09604, L-09677, L-10567, L-14932, L-15688, L-25446, L-29679, L-29813, L-31465, L-32147, L-32171, L-32352, L-32382, L-32383, L-32566, L-32893, L-33672, L-33725, L-34033
EMISSIVITY C-03542
EMPHYSEMA A-31759, G-07821, G-27137, L-03198
EMULSIONS B-05532, B-09839, B-23493
ENFORCEMENT PROCEDURES A-24500, A-25638, B-00975, B-02794, B-25479, B-29628, C-08678, D-23149, D-23152, K-11734, L-00549, L-01528, L-02294, L-02840, L-03198, L-07781, L-09215, L-17258, L-23754, L-26940, L-27184, L-27678, L-27679, L-28363, L-29679, L-31084, L-31465, L-32147, L-32171, L-32383, L-33725, L-35752
ENGINE DESIGN MODIFICATION A-08802, A-12377, A-12505, A-14297,

A-14914, A-27129, A-31759, A-32653, B-00504, B-06280, B-06453, B-07224, B-07479, B-08497, B-23067, B-24988, B-31400, L-09215
ENGINE EXHAUSTS A-00393, A-01565, A-05007, A-05527, A-05608, A-06039, A-08802, A-09255, A-11692, A-12377, A-14116, A-15297, A-16135, A-20101, A-20118, A-20125, A-20557, A-21700, A-25327, A-26048, A-27249, A-27451, A-28352, A-30603, A-30851, A-32465, A-32653, A-33648, A-33719, A-34018, A-34766, A-34891, A-34964, A-35590, A-35635, B-00504, B-06280, B-06453, B-06525, B-06636, B-06979, B-07224, B-07479, B-08497, B-08604, B-08663, B-09608, B-11220, B-11234, B-12133, B-17906, B-20120, B-20877, B-20878, B-24845, B-24988, B-25594, B-27401, B-29437, B-29533, B-30260, B-31167, B-31400, B-33077, C-02786, C-03542, C-05170, C-07266, C-09476, C-09620, C-14197, C-14607, C-14680, C-16298, C-16442, C-16781, C-20100, C-22448, C-26966, C-27121, C-27248, C-27934, C-31222, D-00241, D-00251, D-03001, D-03017, D-18231, D-25291, D-27255, D-33108, E-19849, G-00177, K-00157, K-16263, L-04888, L-05129, L-09215, L-09677, L-34926, L-35511, M-23408
ENGINE OPERATING CYCLES A-01565, A-05007, A-08802, A-28352, A-32653, B-01613, B-05490, B-06280, B-08604, B-08663, B-09608, C-16442, C-22448, D-00241, D-00251, G-00177, L-03198
ENGINE OPERATION MODIFICATION A-01565, A-02001, A-05335, A-05549, A-06039, A-08802, A-09255, A-10075, A-12377, A-12505, A-14297, A-14914, A-20118, A-21700, A-26048, A-27129, A-27249, A-27986, A-28352, A-30851, A-35590, B-01613, B-04361, B-06280, B-06525, B-06979, B-07224, B-08497, B-08663, B-09608, B-19850, B-20120, B-21220, B-23067, B-24988, B-25594, B-28108, B-30865, B-31400, B-31631, B-32119, B-35566, C-03542, L-04888, N-20495
ENGINEERS L-14616, L-30688, L-33672
ENZYMES C-35182, G-07821
EPIDEMIOLOGY C-08953, C-16080, G-27137
EPITHELIUM F-11132, F-19102, G-19599, N-05235
EQUIPMENT CRITERIA A-19366, A-35638, B-14341, B-14687, B-29323, B-31062, B-32057, L-32354
EQUIPMENT STANDARDS A-25638, A-28861, A-34290, B-00504, B-23319, B-29323, K-15926, K-31286, L-15688, L-19059, L-33672
ESTERS A-07561, A-32475, B-15772, B-16890, B-21294, B-22988, C-03354, C-08357, C-08953, C-10983, C-11167, C-11486, C-14109, C-28393, C-29269, C-32269
ETHERS A-07089, B-16890, B-22838, C-11123, C-27934, D-00251, F-19102, G-00177
ETHYL ALCOHOL B-05409, C-07214, C-11123, C-30704
ETHYLENE A-26911, B-22838, B-28118, B-32956, C-07214, D-00251, D-23152, K-11734
EUROPE A-00393, A-00525, A-01885, A-02001, A-03097, A-08373, A-08802, A-09255, A-10075, A-11651, A-11969, A-12377, A-14297, A-21700, A-21882, A-21887, A-22987, A-23000, A-23843, A-24754, A-25179, A-25205, A-25638, A-29353, A-30218, A-30327, A-30389, A-30603, A-31323, A-31882, A-33648, A-33713, A-33719, A-33883, A-34585, B-00257, B-00286, B-00358, B-00379, B-00504, B-00975, B-01352, B-01414, B-01505, B-01508, B-01537, B-01549, B-01563, B-01867, B-01900, B-02047, B-02279, B-02427, B-02725, B-03129, B-03499, B-03807, B-03966, B-03972, B-03976, B-04045, B-04300, B-04361, B-04664, B-04666, B-04773, B-05624, B-06280, B-07224, B-07362, B-07374, B-07530, B-07531, B-08361, B-08467, B-08497, B-08604, B-09656, B-09661, B-09933, B-10588, B-11059, B-11843, B-13334, B-13697, B-13812, B-14004, B-14013, B-14453, B-14671, B-14692, B-15153, B-16113, B-16365, B-17266, B-20369, B-21294, B-21702, B-21888, B-22400, B-22525, B-23319, B-23456, B-23493, B-23885, B-24065, B-24743, B-24969, B-25085, B-25224, B-25479, B-25711, B-25858, B-26176, B-26908, B-27154, B-27719, B-28108, B-28118, B-28206, B-29278, B-29363, B-30339, B-30350, B-30809, B-31072, B-31167, B-31178, B-31301, B-31302, B-31400, B-31472, B-32057, B-32302, B-32781, B-32956, B-33816, B-33854, B-34778, B-35955, C-00178, C-00965, C-02786, C-03010, C-03354, C-03542, C-07214, C-08953, C-09648, C-09657, C-09716, C-10029, C-11486, C-12942, C-14197, C-15287, C-16080, C-16298, C-20538, C-21652, C-24071, C-25466, C-28393, C-29243, C-29269, C-29891, C-30014, C-32269, C-35182, C-35949, D-00209, D-00251, D-00373, D-00751, D-01202, D-01949, D-02331, D-03514, D-05256, D-16635, D-16636, E-14906, E-26550, F-01784, F-03173, F-16696, F-24354, F-24531, G-00177, G-00208, G-00715, G-05942, G-05943, G-05946, G-05949, G-07821, G-09659, G-11476, G-21125, G-21712, G-34686, G-35671, K-05117, K-05947, K-18294, K-20194, K-21083, K-21084, K-30870, K-31286, K-35146, L-01528, L-02294, L-02295, L-02840, L-03198, L-04888, L-07235, L-09215, L-12376, L-14028, L-14616, L-14798, L-22343, L-26511, L-31084, L-32354, M-00376, M-00487, M-00844, M-15760, N-03438, N-05235, N-32254
EVAPORATORS A-09853, A-32879, B-04861, B-04951, B-09508, B-09655, B-09656, B-09933, B-11008, B-11153, B-12658, B-15709, B-16747, B-16842, B-18140, B-19218, B-21051, B-22522, B-26176, B-30062, B-32615, B-32681, B-32798, B-32937, B-34385, D-09592
EXCESS AIR A-10075, A-27986, A-28861, B-04781, B-04783, B-04838, B-05852, B-08360, B-09830, B-10009, B-23836, B-26731, B-32498, I-19325
EXCRETIONS A-25179, B-03297, B-04664, B-14453, B-33398, C-13099, C-17639
EXHAUST SYSTEMS A-04860, A-09853, A-12998, A-27235, A-31155, B-01672, B-06088, B-09656, B-09784, B-09791, B-09813, B-09815, B-09819, B-09842, B-09852, B-09854, B-10005, B-18140, B-22435, B-25017, B-27818, B-30943, B-31453, B-32847, B-33617, B-35609, C-17638, I-24187, L-04942, L-30149, L-31084
EXPERIMENTAL EQUIPMENT A-04785, A-08359, B-00257, B-04627, B-04664, B-04783, B-07362, B-07374, B-13398, C-08355, C-08356, C-09364, C-09521, C-10029, C-10593, C-26837, C-34972, E-14906, L-04841, N-05235
EXPERIMENTAL METHODS A-00393, A-03825, A-04785, A-04879, A-08359, B-01867, B-04627, B-08506, B-16890, C-03010, C-08354, C-08356, C-08357, C-08953, C-09364, C-10534, C-34972, C-35240, D-05256, D-18231, G-05946, G-09659, K-05947, L-04888, N-05235
EXPLOSIONS A-32489, B-04861, B-24810
EXPOSURE CHAMBERS C-00965, C-08768, C-11123, C-17638, C-18194, C-23755, D-18231, F-16455, G-00177
EXPOSURE METHODS A-34287, C-05396, C-07266, C-11123, D-00751, D-18231, G-00715, G-07091, L-34926
EYE IRRITATION A-00402, A-17603, A-20557, A-24459, A-31759, B-04533, B-06280, B-31700, C-02786, C-03542, C-07266, D-03514, E-19849, F-25761, G-00177, G-11476, G-28175, G-35570, K-11734, K-31968, K-35146, M-00376, M-14491
EYES B-06280, B-31400, C-21652, C-34972, G-00177, G-11476, K-11734, K-21083, K-21084, K-30870, K-35146

F

FADING D-09590, I-05463
FALLOUT A-03097
FANS (BLOWERS) A-12998, A-27235, A-31155, B-01672, B-09784, B-09791, B-09813, B-09815, B-09819, B-09842, B-25017, B-30943, B-31453, B-32847, B-33617, B-35609, C-17638, L-30149, L-31084
FARMS A-26911, A-33713, A-35564, B-14453, B-20709, B-22550, B-25858, B-33120, H-00252
FEASIBILITY STUDIES B-06103, B-12346, B-14687, N-19088
FEDERAL GOVERNMENTS A-21882, B-00504, B-06280, B-07971, B-29628, K-11734, L-01528, L-02294, L-02295, L-03540, L-22343, L-23754, L-27185, L-29813, L-32352, L-32893, L-33117, L-34256, L-35694, M-08698
FEED LOTS B-03297, B-22550, B-32682, C-28141
FEES L-32382, L-32383, L-33725
FEMALES C-02786, C-08268, D-00751, M-00844, M-01069
FERTILIZER MANUFACTURING A-12834, A-17198, A-17631, A-19899, A-20706, A-22987, A-23000, A-29599, A-32855, A-34018, A-35693, B-12480, B-17635, B-20709, B-24380, B-26567, B-32099, C-23106, C-30811, D-33108, G-21125, K-31516, L-32796
FERTILIZING A-17236, B-00571, B-03129, B-22550, B-32682, D-23411, L-15688
FIELD TESTS A-35673, B-00257, B-00975, B-02047, B-03976, B-05490, B-06366, B-08104, B-09508, B-09608, B-09840, B-11009, B-11220, B-14609, B-22538, B-23008, B-32559, C-08066, C-08358, K-18294

FILTER FABRICS A-10699, B-01414, B-03966, B-07875, B-09784, B-09813, B-09815, B-14354, B-19221, B-21938, B-24090, B-26254, B-31301, C-02786, C-09619, C-17288, C-17627, C-17628, C-17641, C-20202, C-26547, C-27685, C-31222, C-35956, D-09590, G-00177, J-34518, L-07235, M-31071
FILTERS A-04785, A-10699, A-11969, A-20134, A-24903, A-25228, A-26402, A-33188, A-34287, A-35564, B-00257, B-00286, B-01352, B-01414, B-03966, B-05624, B-07875, B-08104, B-09784, B-09794, B-09813, B-09815, B-09830, B-09839, B-09849, B-09852, B-11059, B-12434, B-13551, B-14354, B-14687, B-14951, B-16113, B-18169, B-19221, B-20754, B-20817, B-21006, B-21702, B-21888, B-21938, B-22357, B-22435, B-23319, B-23371, B-23885, B-24090, B-24810, B-25017, B-25694, B-26254, B-26843, B-27336, B-28146, B-29323, B-29437, B-29533, B-30124, B-30479, B-30530, B-30782, B-31211, B-31233, B-31301, B-31302, B-31354, B-31945, B-32634, B-32781, B-32847, B-32913, B-32935, B-33003, B-35955, C-02786, C-03010, C-04117, C-06112, C-09619, C-17288, C-17627, C-17628, C-17641, C-20202, C-21859, C-23004, C-26547, C-27685, C-29337, C-30704, C-31222, C-34279, C-35956, D-02212, D-09590, D-20355, G-00177, I-05463, J-34518, L-04942, L-07235, L-14028, M-31071, N-03438
FIRING METHODS A-07561, A-10075, A-10699, A-14297, A-24007, A-26911, A-27249, A-27986, A-28861, A-30603, A-34290, A-34654, A-34891, B-04361, B-04781, B-04783, B-04838, B-05852, B-08360, B-09656, B-09827, B-09830, B-09933, B-10009, B-11153, B-11158, B-17409, B-22522, B-23836, B-23885, B-25554, B-26730, B-26731, B-27288, B-27541, B-27818, B-31091, B-31453, B-31631, B-32119, B-32302, B-32498, B-32937, B-33077, B-33617, B-33793, B-35566, B-35803, D-09592, I-19325, K-07766, L-07235
FLAME AFTERBURNERS A-08912, A-09853, A-20276, A-24007, A-25179, A-29332, A-32465, A-34585, B-00257, B-01414, B-02047, B-03499, B-04669, B-05852, B-06088, B-06366, B-09508, B-09791, B-09830, B-09849, B-09852, B-09854, B-11059, B-11136, B-11137, B-13971, B-14757, B-19493, B-20817, B-20824, B-21888, B-22525, B-23967, B-26843, B-26944, B-27793, B-30738, B-32559, B-33077, C-24429, C-25065
FLAME IONIZATION DETECTOR A-05549, A-06981, A-08373, A-20101, A-23843, A-29698, A-33564, B-00286, B-02279, B-03966, B-16842, B-32302, C-05426, C-06112, C-07214, C-08066, C-08354, C-09521, C-09619, C-09620, C-09657, C-10016, C-10029, C-10693, C-13099, C-14680, C-17627, C-19051, C-20100, C-20192, C-20202, C-26547, C-28141, C-28787, C-29337, C-29843, C-34279, C-34863, C-35648, C-35949, C-35956, F-01784, F-19063, K-31286
FLARES B-02729, B-08946, B-09836, B-09840, B-09849, B-31223
FLORIDA A-14972, B-08364, L-00973, L-09677
FLOUR PROCESSING B-24810
FLOW RATES A-28861, B-01563, B-03966, B-04887, B-07362, B-08360, B-08364, B-09791, B-09813, B-09827, B-09842, B-12346, B-16890, B-21938, B-23493, B-24197, B-26836, B-27605, B-27818, B-29131, B-29323, B-29978, B-31211, B-31456, B-32302, B-33073, B-34073, B-34385, B-34778, C-03010, C-08355, C-08356, C-24429, C-34047
FLOWERS D-00751, D-09590, K-11734
FLOWMETERS B-00257, B-04882, C-03789, C-08356, C-08358, C-17640, C-35956
FLUID FLOW A-28861, B-01563, B-03966, B-03976, B-04887, B-04949, B-07362, B-08360, B-08364, B-09791, B-09813, B-09827, B-09842, B-12346, B-16890, B-21938, B-23493, B-24197, B-25623, B-26836, B-27605, B-27818, B-29131, B-29323, B-29978, B-31211, B-31456, B-32302, B-32497, B-33073, B-33077, B-34073, B-34385, B-34778, C-03010, C-08355, C-08356, C-08678, C-24429, C-34047, C-35956
FLUORANTHENES D-00251
FLUORENES B-02725
FLUORESCENCE A-35635, C-03542, C-05426, C-05813, C-27248, C-35949
FLUORIDES A-20134, A-26911, A-34018, B-14692, B-26254, C-03010, C-05813, C-27248, C-30014, C-35956, D-01949, D-03514, D-09590, D-23845, L-00973, L-09677
FLUORINE A-25638, B-03129, B-26908, C-09476, K-31968, L-01528, N-19060
FLUORINE COMPOUNDS A-20134, A-22973, A-26911, A-32855, A-34018, B-13551, B-14692, B-26254, B-32302, C-03010, C-05813, C-06112, C-09476, C-27248, C-30014, C-35956, D-01949, D-03514, D-09590, D-23845, D-31371, L-00973, L-07235, L-09677, L-32354, N-20495, N-32254
FLUOROSIS A-22973
FLY ASH A-00402, A-07561, A-09175, A-11651, A-26605, A-29353, A-34228, A-34290, B-00246, B-08360, B-09852, B-10009, B-13551, B-16842, B-23008, B-25694, B-26087, B-26778, B-26908, B-28146, B-31453, B-33077, B-35566, D-09590, L-00973, L-02840, L-07235, L-07781, L-09677, L-19059, L-30149
FOG B-16842, D-09592, L-14616, M-00376, M-26725
FOOD AND FEED OPERATIONS A-07394, A-08912, A-09853, A-11700, A-12834, A-17198, A-17631, A-17632, A-20553, A-21887, A-23313, A-23314, A-24350, A-24754, A-25179, A-25228, A-26826, A-26911, A-29842, A-30389, A-31044, A-31263, A-31602, A-32855, A-32879, A-33713, A-34018, A-35564, A-35693, B-00246, B-01414, B-02794, B-03972, B-04943, B-05532, B-05624, B-05930, B-06412, B-07362, B-07374, B-07530, B-07531, B-08467, B-09784, B-09791, B-09852, B-09854, B-11059, B-12480, B-12482, B-13551, B-14671, B-14940, B-15153, B-16535, B-17635, B-17636, B-17637, B-18169, B-20628, B-20824, B-21677, B-21888, B-22525, B-23002, B-23456, B-23967, B-24810, B-25379, B-25858, B-25977, B-26002, B-26057, B-26128, B-26254, B-26843, B-27154, B-27548, B-29745, B-30350, B-30943, B-31178, B-32099, B-32166, B-32682, B-32768, B-32781, B-32797, B-33120, B-33398, B-33816, B-33854, B-35595, C-03354, C-05614, C-08066, C-22431, C-22958, C-26966, C-27791, C-29726, C-30689, C-30811, C-31924, C-32467, C-33577, D-02212, D-02331, D-03418, D-09592, D-17630, D-27255, L-22343, L-32796, L-32893, L-33117, N-03438
FOODS C-03354, C-35648
FORESTS A-19814
FORMALDEHYDES A-05549, A-06039, A-23843, A-27451, A-32855, A-34891, A-35673, B-04533, B-05808, B-06636, B-11234, B-20877, B-20878, B-24090, B-29533, B-31700, C-02786, C-03010, C-03542, C-05170, C-07266, C-11123, C-31924, D-00241, D-00251, D-31371, E-19849, G-00177, L-04888
FRACTIONATION C-08356, C-08357, F-16696
FRANCE B-00504, B-04773, B-13812, B-28108, B-30809, C-29269, F-24354, F-24531, L-03198, L-04888
FREE RADICALS F-29649, G-07821
FREEZING C-08355, C-08356, C-08358, C-10534, C-35956
FROTH FLOATATION B-09839
FRUITS B-04943, K-11734
FUEL ADDITIVES A-06039, A-09255, A-12505, A-14914, A-27249, A-32653, A-34891, A-35622, B-00504, B-06280, B-06525, B-06979, B-07479, B-07971, B-09608, B-11220, B-11234, B-20120, B-20877, B-20878, B-23067, B-24845, B-24988, C-27248, L-03198, L-04888
FUEL CELLS A-31759
FUEL CHARGING A-07561, A-27986, A-34654, A-34891, B-27288, B-31631, B-33077
FUEL EVAPORATION A-01565, A-05007, A-28352, A-32465, A-34018, B-00504, B-17906, B-28118, K-00157, K-16263, L-03198, L-09677, N-19060
FUEL GASES A-17603, A-21395, A-27249, A-28352, A-31759, A-34654, B-00257, B-05852, B-09784, B-09827, B-09922, B-22838, B-23008, B-25479, B-27719, B-31911, B-33077, B-33793, C-14108, D-03431, D-03506, D-09590, D-09592, G-00715, L-04942, L-07235, L-32352
FUEL OIL PREPARATION A-33883, B-26908, B-28118, B-32956
FUEL OILS A-05007, A-09175, A-09255, A-10075, A-23313, A-23314, A-24500, A-25056, A-26048, A-33883, A-34654, A-34891, B-00257, B-01613, B-04361, B-05490, B-06280, B-06979, B-07971, B-09784, B-09836, B-11220, B-22435, B-22518, B-23885, B-26908, B-27719, B-28108, B-28118, B-30260, B-31354, B-32956, B-33077, C-27121, D-00251, D-00751, D-01949, D-03431, D-03506, D-09590, D-09592, D-23411, D-33108, K-31968, L-00054, L-02840, L-07235, L-09215, L-29813
FUEL STANDARDS B-06280, K-00157, K-07766, L-29813, L-32171
FUEL TANK EVAPORATION A-01565, A-05007, A-28352, B-00504, B-17906, K-00157, K-16263
FUELS A-02765, A-05007, A-09175, A-09255, A-10075, A-12505, A-12832, A-12834, A-14914, A-17603, A-21395, A-23313, A-23314, A-24459, A-24500, A-25056, A-25455, A-26048, A-26574, A-27249, A-28352, A-30603, A-31759,

A-31880, A-31882, A-32385, A-32653, A-33648, A-33719, A-33883, A-34018, A-34654, A-34891, A-35622, B-00257, B-00975, B-01613, B-01672, B-02725, B-04361, B-04838, B-05490, B-05852, B-06280, B-06636, B-06979, B-07224, B-07875, B-07971, B-08663, B-09784, B-09827, B-09836, B-09922, B-11220, B-20369, B-22435, B-22518, B-22838, B-23008, B-23885, B-24743, B-25479, B-25594, B-26908, B-27719, B-28108, B-28118, B-29628, B-30260, B-30865, B-31167, B-31223, B-31354, B-31631, B-31911, B-32497, B-32956, B-33077, B-33793, B-33854, C-03542, C-06112, C-14108, C-27121, C-27934, D-00251, D-00690, D-00751, D-01949, D-03017, D-03431, D-03459, D-03506, D-03514, D-09590, D-09592, D-16636, D-23411, D-29973, D-31760, D-33108, D-33539, G-00177, G-00715, J-29299, K-00157, K-07766, K-18294, K-21084, K-31968, L-00054, L-00973, L-02840, L-04942, L-07235, L-07781, L-09215, L-09604, L-09677, L-12511, L-29679, L-29813, L-32171, L-32352, L-32383, L-32626, L-34033, L-34926, L-35511, N-03438, N-32254

FUMES A-07561, A-08912, A-17634, A-24007, A-26402, A-27235, A-30687, A-32489, B-00257, B-00379, B-00541, B-01352, B-01537, B-01549, B-02427, B-02725, B-03129, B-04533, B-04943, B-04949, B-05929, B-06366, B-08506, B-09733, B-09784, B-09791, B-09794, B-09813, B-09815, B-09819, B-09836, B-09839, B-09840, B-09842, B-09849, B-09857, B-11137, B-14341, B-17906, B-18140, B-20817, B-24969, B-25017, B-26308, B-26944, B-27818, B-30943, B-31456, B-31700, B-31945, B-32634, B-32781, B-33793, B-35554, C-03010, C-05503, C-07214, C-15287, C-23107, D-00241, D-00251, D-03514, D-05481, D-18231, I-24187, J-29299, L-01528, L-04942, L-07781, L-09677, L-30149, L-31084, L-32171, L-32382

FUMIGATION B-01672, B-09608, D-09592, L-04888

FUNGI G-07091

FURNACES A-02001, A-04879, A-06981, A-08359, A-10075, A-11144, A-25056, A-25205, A-25638, A-26402, A-26574, A-28614, A-28885, A-29455, A-31157, A-32489, A-33719, A-34018, A-34290, A-35383, B-00975, B-02725, B-04361, B-04783, B-04861, B-05880, B-06106, B-07971, B-09655, B-09656, B-09784, B-09827, B-09933, B-10994, B-11008, B-11153, B-11158, B-14118, B-16747, B-16842, B-17635, B-19363, B-20258, B-23002, B-23885, B-25085, B-26254, B-26567, B-27541, B-31223, B-31301, B-31453, B-31631, B-31790, B-32119, B-32498, B-32615, B-32681, B-32913, B-32937, B-33077, B-33793, B-35554, C-00965, C-03010, C-35956, D-09592, D-29973, K-31286, K-31968, L-01528, L-02840, L-07235, L-07781, L-09604, L-09677, L-29975, L-30149, L-31084, N-32254

G

GAS CHROMATOGRAPHY A-01644, A-03825, A-05549, A-06981, A-08373, A-15297, A-16494, A-17633, A-19814, A-20101, A-20557, A-21978, A-23843, A-25228, A-25327, A-25455, A-28527, A-29698, A-30687, A-31044, A-31263, A-32475, A-33564, A-34766, B-00032, B-00286, B-00379, B-00571, B-02279, B-03966, B-04882, B-05408, B-05409, B-05808, B-06525, B-06979, B-12480, B-16842, B-17636, B-23371, B-24380, B-32099, B-32166, B-32302, B-34679, C-01289, C-02786, C-04883, C-05426, C-06112, C-06526, C-07214, C-08066, C-08354, C-08355, C-08356, C-08357, C-08358, C-09521, C-09619, C-09620, C-09657, C-10016, C-10029, C-10534, C-10593, C-10693, C-12488, C-12942, C-13099, C-13143, C-13749, C-13969, C-14197, C-14680, C-15287, C-16134, C-17288, C-17627, C-17628, C-17629, C-19051, C-20100, C-20192, C-20202, C-20264, C-20460, C-20624, C-21859, C-22431, C-23004, C-24814, C-26547, C-27121, C-27355, C-27475, C-27685, C-27791, C-28141, C-28787, C-29337, C-29726, C-29843, C-30014, C-30374, C-30704, C-31222, C-31924, C-32467, C-32795, C-32880, C-34279, C-34863, C-35541, C-35648, C-35751, C-35949, C-35956, D-00209, D-23098, D-29349, D-31371, F-01784, F-10308, F-13670, F-19061, F-19063, G-00177, G-03788, K-31286, L-35752

GAS SAMPLING A-00525, A-04785, A-05608, A-09175, A-14580, A-33713, A-34964, A-35622, B-01414, B-03966, B-04882, B-04887, B-05808, B-09784, B-13971, B-32166, C-00965, C-02786, C-03789, C-04117, C-04883, C-05426, C-05614, C-06112, C-08066, C-08355, C-08356, C-08358, C-09521, C-09620, C-09657, C-09860, C-10016, C-10593, C-12492, C-13969, C-16781, C-17628, C-17629, C-20460, C-23004, C-24814, C-26547, C-29726, C-35865, C-35956, D-00241, D-05481, D-09590, D-31760, F-10308

GAS TURBINES A-05549, A-27129, A-27249, A-27451, B-07362, B-07971, B-30865, D-09592

GASES A-00393, A-05007, A-06981, A-09175, A-14580, A-21395, A-22860, A-24527, A-34228, B-00358, B-00975, B-01505, B-01563, B-04949, B-05408, B-05409, B-05808, B-07374, B-07531, B-08360, B-09655, B-09656, B-09661, B-09836, B-10005, B-15779, B-20625, B-25085, B-27719, B-29323, C-07214, C-08354, C-08355, C-08356, C-08357, C-08358, C-08953, C-09619, C-09620, C-09648, C-09657, C-09660, C-10016, C-10593, C-23106, C-29858, C-32467, D-01202, D-01949, F-10308, F-16696, G-05942, G-05946, G-21125, L-32382, L-33672

GASOLINES A-05007, A-24459, A-30603, A-32653, A-33648, A-33883, A-34018, B-07224, B-08663, B-09836, B-25594, B-28108, B-29628, B-31167, B-31354, C-27934, D-00751, D-01949, D-09592, D-29973, G-00177, K-00157, K-07766, K-18294, K-21084, L-09215, L-32171, L-32383, L-34033, L-34926

GERMANY A-08373, A-08802, A-11651, A-11969, A-21700, A-21882, A-21887, A-23843, A-24754, A-25179, A-25638, A-30218, A-33713, A-33719, A-34585, B-01537, B-07224, B-07362, B-07374, B-07530, B-07531, B-08497, B-08604, B-11059, B-13697, B-14004, B-14453, B-14671, B-15153, B-16113, B-20369, B-21294, B-21702, B-21888, B-22525, B-23493, B-23885, B-24065, B-24969, B-25224, B-25711, B-25858, B-28118, B-30350, B-31167, B-31301, B-31302, B-31472, B-32057, B-32781, B-32956, B-33854, C-12942, C-15287, C-16298, C-20538, C-28393, C-30014, G-07821, G-21125, G-21712, G-34686, K-35146, L-01528, L-07235, L-14028, L-22343, L-26511, L-32354, N-32254

GLADIOLI D-09590

GLASS FABRICS A-10699, B-01414, B-03966, B-09784, B-19221, B-21938, B-24090, B-26254, C-02786, C-17288, C-17627, C-17628, C-17641, C-20202, C-26547, C-27685, C-31222, D-09590

GLUE MANUFACTURING A-34018, B-05624

GOATS B-25858

GOVERNMENTS A-08912, A-12832, A-12834, A-21882, A-23313, A-23314, A-25638, A-28295, A-32855, A-34290, B-00504, B-00975, B-01672, B-06280, B-07971, B-09784, B-16890, B-25479, B-26057, B-29628, B-32057, C-03010, C-11167, D-01949, D-03459, D-09590, D-23411, D-29973, D-35764, K-00157, K-11734, K-15926, L-00054, L-00549, L-00871, L-01528, L-02294, L-02295, L-03540, L-07235, L-07781, L-09604, L-09677, L-12511, L-14028, L-14616, L-14932, L-15554, L-15691, L-17258, L-19059, L-22343, L-23754, L-25446, L-26940, L-27184, L-27185, L-27677, L-27678, L-27679, L-28348, L-28363, L-29679, L-29813, L-30153, L-32147, L-32171, L-32352, L-32354, L-32382, L-32383, L-32626, L-32893, L-33117, L-33725, L-34256, L-34755, L-35694, L-35752, M-08698, M-24091, N-03438, N-32254

GRAIN PROCESSING A-35564, B-09784, D-02212, D-09592

GRANTS L-00549, L-03540

GRAPHITE B-09840, B-20369

GRASSES A-34018

GRAVITY SETTLING B-09839, B-35955

GREAT BRITAIN A-09255, A-12377, A-14297, A-29353, A-30603, A-31323, B-01352, B-04300, B-05624, B-06280, B-10588, B-24743, B-26908, B-27154, B-28206, B-31178, B-31400, B-32302, B-33816, B-34778, B-35955, C-24071, E-26550, F-16696, K-31286, L-12376, L-31084

GREENHOUSES D-09590

GROUND LEVEL A-29353, A-35638, B-04361, B-31223, D-09590, D-29973, E-14906, L-29813, L-32566

GUINEA PIGS G-07821

H

HALOGEN GASES A-24459, A-25638, A-34018, B-00379, B-00552, B-03129, B-03807, B-04861, B-04887, B-06636, B-09729, B-09839, B-18169, B-25623, B-26176, B-26908, B-30350, B-32646, C-03010, C-04883, C-09476, C-09657, C-11123, C-23107, C-29269, C-29843, D-23152, D-31371, D-33108, F-10308, G-05946, G-07091, K-31968, L-01528, N-19060

HALOGENATED HYDROCARBONS A-17634, A-32475, B-04838, B-21294, B-26843, B-28756, B-31233, B-32119, C-05813, C-08066, C-10983, C-11123, C-18093, D-00251, F-19102, K-21083, K-30870, L-14028

HAMSTERS G-07821

HAZE A-35622, B-02047, L-34926, M-00376

HEADACHE A-20553, A-30687, A-31263, B-01672, D-02339, G-07821, G-28175, K-31968

HEALTH IMPAIRMENT A-20553, A-26911, A-31602, A-31759, A-33828, A-35622, B-00975, B-01672, B-02427, B-02794, B-09819, B-26087, C-29891, D-00373, D-02339, D-03017, D-03514, D-09590, D-35764, F-25761, G-00177, G-05942, G-05949, G-07821, G-27137, G-34667, G-35570, K-11734, K-31968, L-00054, L-00871, L-07235, L-22343, L-32566, L-34256, L-34926

HEARINGS L-06732, L-23754, L-32171, L-32383, N-03438

HEART G-35671, H-00252

HEAT CAPACITY B-00257

HEAT OF COMBUSTION A-24754, A-27249, B-33077

HEAT TRANSFER A-04879, A-07394, A-21395, A-26605, A-29455, A-33648, A-34654, B-07362, B-07531, B-09794, B-09842, B-10009, B-14094, B-24065, B-24079, B-24197, B-25085, B-26308, B-31911, B-32119, B-32498, B-32559, B-32781, B-32937, B-34778, B-35554, C-08355, C-08356, C-08358, C-10534, C-35956, J-29299

HEIGHT FINDING E-26550

HEMATOLOGY A-30513, D-24162, D-27255, G-05949, K-05947, L-03198, N-20495

HEMEON AUTOMATIC SMOKE SAMPLERS B-00975, D-00690

HEPTANES B-07224

HEPTENES G-00177

HERBICIDES B-00571, B-32682

HEXANES B-01414, G-00177

HEXENES D-00251, G-00177

HI-VOL SAMPLERS A-28614, C-20192, C-23107, D-02212, D-05481, D-31760, L-00054, L-02840, N-03438

HIGHWAYS D-31371

HOGS B-25858, B-33120, C-13099, H-00252

HORMONES F-33084, G-07821

HOT SOAK A-05007, L-09677

HOURLY A-31263, C-08678, D-03001, D-03017, K-31516, L-32382, L-32383

HUMANS A-00402, A-30513, A-31323, A-31759, A-32878, A-34018, A-35581, B-05490, B-08104, B-08604, B-09827, B-27288, B-31354, C-02786, C-03542, C-05614, C-05898, C-07266, C-08066, C-08268, C-08953, C-09660, C-10593, C-12665, C-14108 C-14606, C-16442, C-16540, C-17290, C-20624, C-21693, C-21866, C-24429, C-26966, C-27934, C-29269, C-29891, C-29929, C-33121, D-00751, D-18231, D-23098, D-27255, D-31760, D-33108, G-00177, G-00208, G-00715, G-05942, G-05946, G-05949, G-07821, G-09659, G-11476, G-21125, G-21712, G-27137, G-34667, G-34686, G-35570, G-35671, K-05947, K-11734, K-20194, K-21083, K-30870, K-35146, L-07235, L-34256, L-34926, M-00376, M-00844, M-01069, M-13980, N-03438

HUMIDITY A-34290, B-00358, B-01672, B-03976, B-05490, B-27288, B-32070, B-35955, C-08358, C-08678, C-21208, C-25065, C-26966, C-35956, D-01202, D-06535, D-31760, G-00177, I-05463, L-00054, L-02840, L-04888

HYDRAZINES C-27733, K-21918

HYDROCARBONS A-01565, A-01885, A-02001, A-04785, A-05007, A-05335, A-05549, A-06039, A-07089, A-07394, A-07561, A-08359, A-08373, A-08802, A-09175, A-09255, A-10075, A-10699, A-11692, A-12377, A-12998, A-14116, A-14297, A-16135, A-16494, A-19814, A-19899, A-20101, A-20125, A-20134, A-20276, A-21661, A-23843, A-24459, A-24527, A-25327, A-25455, A-26911, A-27129, A-27235, A-27249, A-27451, A-28352, A-28527, A-29599, A-29842, A-30513, A-30603, A-31323, A-31759, A-31880, A-32411, A-32465, A-32475, A-32489, A-32653, A-32855, A-33564, A-33648, A-33719, A-33983, A-34018, A-34290, A-34585, A-34766, A-34891, A-34964, A-35564, A-35635, B-00257, B-00379, B-00504, B-00975, B-01414, B-01508, B-01867, B-02725, B-03129, B-03966, B-04361, B-04627, B-04669, B-04838, B-05409, B-05929, B-06280, B-06366, B-06636, B-07224, B-07362, B-07971, B-08497, B-08506, B-08604, B-08663, B-09655, B-09784, B-09830, B-09836, B-09839, B-09840, B-09842, B-09857, B-11234, B-12133, B-13551, B-14004, B-14203, B-14341, B-14609, B-14757, B-14967, B-15772, B-16498, B-16842, B-16890, B-17906, B-18050, B-19850, B-20369, B-22353, B-22838, B-24845, B-24969, B-24988, B-26944, B-27401, B-27674, B-27818, B-28047, B-28118, B-29437, B-29533, B-29745, B-29978, B-30738, B-30865, B-31062, B-31233, B-31354, B-31400, B-32302, B-32497, B-32559, B-32956, B-33077, B-34679, C-01289, C-02786, C-03010, C-03354, C-03542, C-05170, C-06112, C-07214, C-08066, C-08354, C-08356, C-08357, C-08953, C-09476, C-09521, C-09619, C-10693, C-11123, C-11486, C-14109, C-14607, C-14680, C-15287, C-16298, C-16781, C-18093, C-20100, C-20460, C-20538, C-24814, C-26837, C-27121, C-27248, C-27934, C-29269, C-29337, C-29843, C-29858, C-30704, C-31222, C-31924, C-32269, C-33349, C-34279, C-34972, C-35956, D-00241, D-00251, D-00373, D-01202, D-01949, D-03506, D-06535, D-09592, D-23149, D-23152, D-24162, D-29349, D-29973, D-31760, D-33539, E-19849, F-01784, F-16828, F-17801, F-29649, G-00177, G-00715, G-05949, G-11476, K-00157, K-11734, K-16263, K-18294, K-21083, K-30870, K-31968, L-00054, L-00973, L-01604, L-04888, L-07235, L-09677, L-14616, L-14798, L-32147, L-32354, L-32796, L-34926, M-08698, M-24091, N-03438, N-20495, N-32254

HYDROCHLORIC ACID A-30218, A-32855, B-04943, B-05332, B-06106, B-26254, B-29363, B-30350, B-32119, C-11123, C-23107, C-31924, D-31371, G-05942, G-05946, G-35570, I-19325, L-32354

HYDROCYANIC ACID A-32855, D-35764, L-27678, L-27679

HYDRODESULFURIZATION B-32956

HYDROFLUORIC ACID A-30218, B-26254, D-09590, D-33108, D-35764, L-27677

HYDROGEN B-32646, C-08354, D-00373, D-03017, F-16828, L-02840

HYDROGEN SULFIDE A-04879, A-04893, A-06240, A-11144, A-12507, A-14580, A-17603, A-17631, A-17633, A-25179, A-25228, A-28885, A-29599, A-31263, A-32475, A-32855, A-32879, A-34018, A-34287, A-35564, B-00025, B-00379, B-00975, B-01414, B-01505, B-01508, B-01549, B-01563, B-01672, B-01900, B-02018, B-02279, B-02488, B-03807, B-04627, B-04664, B-04666, B-04773, B-04781, B-04783, B-04861, B-04882, B-04887, B-04952, B-04953, B-05408, B-05409, B-05624, B-05808, B-05880, B-06106, B-07434, B-07531, B-07875, B-08364, B-08467, B-08946, B-09508, B-09655, B-09839, B-09840, B-09854, B-09922, B-10277, B-10994, B-11008, B-11009, B-11673, B-13072, B-14094, B-14113, B-14118, B-14203, B-14488, B-15690, B-15779, B-16842, B-17293, B-17409, B-17637, B-18140, B-19218, B-19850, B-20625, B-20824, B-21051, B-22061, B-22400, B-22522, B-22837, B-22838, B-23117, B-23538, B-23594, B-23901, B-25224, B-25623, B-25950, B-26014, B-26128, B-26173, B-26254, B-26618, B-26836, B-26908, B-28118, B-29278, B-29448, B-30062, B-30339, B-31091, B-31302, B-31790, B-32615, B-32681, B-32798, B-32937, B-32956, B-33122, B-33380, B-34073, B-35803, C-00965, C-04883, C-05426, C-05503, C-06112, C-07214, C-08066, C-08268, C-08354, C-08355, C-08356, C-08358, C-09619, C-09648, C-09657, C-11123, C-14108, C-14109, C-17629, C-17638, C-17639, C-17640, C-19051, C-21652, C-24429, C-27355, C-27685, C-27934, C-28787, C-29269, C-29726, C-29843, C-30704, C-30811, C-31924, C-34279, C-34863, C-35865, C-35956, D-00209, D-00690, D-01949, D-02339, D-03514, D-06535, D-07572, D-09592, D-12426, D-16062, D-20355, D-23149, D-25996, D-29349, D-31371, D-33108, D-33723, E-22335, F-01784, F-10308, F-14987, F-16828, F-29649, G-00208, G-03788, G-09659, H-00252, K-07766, K-35146, L-00054, L-00871, L-06732, L-07235, L-32352, L-32382, L-32796, M-00376, M-08698, N-19060

HYDROGENATION B-19850, B-32956

HYDROLYSIS A-32411, B-09839, B-09849, B-22400, B-24079

HYDROXIDES A-03825, B-00379, B-09849, B-27674

HYGROSCOPICITY B-21702, B-27674, B-32634

I

ICE C-08358

IDAHO D-06535, D-09592, L-00054, M-08698

ILLINOIS A-07394, A-08912, B-06636, C-35541, D-02331, D-33539, L-00973, L-01604, L-09677, L-30149

IMPINGERS A-33188, B-00975, B-12434, B-30773, B-33077, C-01289, C-03010, C-05426, C-09619, C-09657, C-35956

INCINERATION A-00525, A-04860, A-07394, A-07561, A-08373, A-08912, A-09175, A-10699, A-11651, A-11969, A-12083, A-14972, A-17198, A-17462, A-20276, A-21882, A-22860, A-23313, A-23314, A-24007, A-24350, A-25056, A-26574, A-26575, A-26605, A-27235, A-27821, A-27972, A-28861, A-29332, A-29353, A-29455, A-30218, A-31155, A-31157, A-31602, A-32385, A-33188, A-33719, A-34018, A-34228, A-34290, A-34654, A-35383, B-00246, B-00257, B-00541, B-00975, B-01549, B-02047, B-02427, B-02488, B-04533, B-04773, B-04838, B-04861, B-05852, B-06088, B-06366, B-08360, B-08467, B-08506, B-08946, B-09656, B-09661, B-09784, B-09791, B-09819, B-09827, B-09830, B-09836, B-09839, B-09849, B-09852, B-09857, B-09922, B-10009, B-11059, B-11136, B-11137, B-12434, B-13551, B-13697, B-14609, B-14940, B-14956, B-14967, B-15170, B-16807, B-17403, B-18050, B-22357, B-22435, B-23008, B-23836, B-24197, B-25379, B-25479, B-25950, B-25977, B-26567, B-26568, B-26730, B-26731, B-26778, B-26944, B-27541, B-27548, B-27818, B-28146, B-29251, B-30124, B-30530, B-30738, B-30773, B-30943, B-31062, B-31091, B-31178, B-31302, B-31453, B-31631, B-32119, B-32497, B-32498, B-32634, B-32847, B-32956, B-33003, B-33077, B-33120, B-33617, B-33793, B-33854, B-35554, B-35566, B-35595, B-35609, C-04117, C-05614, C-06381, C-24429, C-26966, C-35956, D-02331, D-07572, D-09592, D-33539, E-26550, I-19325, I-24187, J-16457, J-34518, K-07766, K-31516, L-00054, L-00973, L-07235, L-09604, L-09677, L-10567, L-12511, L-15688, L-19059, L-32171, L-32352, L-32383, L-32796, N-01539, N-03438

INDIANA D-02339, L-00871, L-00973, L-09677

INDUSTRIAL AREAS A-24500, A-31044, A-31263, A-34228, A-35693, B-00358, B-31301, C-35949, D-00690, D-03506, D-03514, D-05481, D-09590, D-12426, D-20355, D-23149, D-23152, D-27255, D-29349, D-31371, D-33108, D-33723, D-35764, G-00208, G-05942, G-05949, H-20028, K-05947, L-00054, L-07235, L-09677, L-10567, L-26511, L-27184, L-27185, L-29813, L-30149, L-32352, L-32354, M-14491

INDUSTRIAL EMISSION SOURCES A-00525, A-01644, A-01885, A-02765, A-04785, A-04860, A-04879, A-04893, A-06240, A-06981, A-07394, A-07561, A-08359, A-08373, A-08912, A-09175, A-09853, A-10699, A-11144, A-11651, A-11700, A-11969, A-12083, A-12507, A-12621, A-12832, A-12834, A-14580, A-14972, A-16058, A-16494, A-17198, A-17462, A-17603, A-17631, A-17632, A-17633, A-17634, A-19366, A-19899, A-20134, A-20276, A-20553, A-20706, A-21882, A-21887, A-22860, A-22973, A-22987, A-23000, A-23313, A-23314, A-23843, A-24007, A-24350, A-24500, A-24527, A-24754, A-24903, A-25056, A-25179, A-25205, A-25228, A-26402, A-26574, A-26575, A-26605, A-26826, A-26911, A-27235, A-27669, A-27821, A-27972, A-28295, A-28527, A-28614, A-28861, A-28885, A-29332, A-29353, A-29455, A-29599, A-29696, A-29842, A-30218, A-30389, A-30513, A-30687, A-30701, A-31044, A-31155, A-31157, A-31263, A-31602, A-31759, A-31880, A-31882, A-32385, A-32465, A-32475, A-32489, A-32653, A-32855, A-32879, A-33188, A-33713, A-33719, A-33828, A-33883, A-33983, A-34018, A-34228, A-34290, A-34585, A-34654, A-35383, A-35564, A-35581, A-35693, B-00025, B-00032, B-00246, B-00257, B-00358, B-00379, B-00541, B-00552, B-00571, B-00975, B-01352, B-01414, B-01505, B-01537, B-01549, B-01563, B-01672, B-01900, B-02018, B-02047, B-02279, B-02427, B-02488, B-02729, B-02794, B-03129, B-03807, B-03946, B-03966, B-03972, B-03976, B-04045, B-04227, B-04300, B-04533, B-04627, B-04669, B-04773, B-04781, B-04783, B-04838, B-04861, B-04882, B-04887, B-04943, B-04950, B-04951, B-04952, B-04953, B-05093, B-05332, B-05408, B-05409, B-05532, B-05624, B-05808, B-05852, B-05862, B-05880, B-05929, B-05930, B-06088, B-06103, B-06106, B-06366, B-06412, B-06688, B-06859, B-07362, B-07374, B-07415, B-07429, B-07434, B-07530, B-07531, B-07875, B-07971, B-08360, B-08361, B-08364, B-08467, B-08506, B-08946, B-09508, B-09655, B-09656, B-09661, B-09733, B-09784, B-09791, B-09794, B-09813, B-09815, B-09819, B-09827, B-09830, B-09836, B-09839, B-09840, B-09842, B-09849, B-09852, B-09854, B-09857, B-09922, B-09933, B-10009, B-10277, B-10588, B-10994, B-11008, B-11009, B-11059, B-11136, B-11137, B-11153, B-11158, B-11673, B-12346, B-12434, B-12480, B-12482, B-12506, B-12658, B-13072, B-13334, B-13398, B-13551, B-13697, B-13772, B-14094, B-14113, B-14118, B-14609, B-14671, B-14757, B-14895, B-14940, B-14956, B-14967, B-15153, B-15170, B-15690, B-15709, B-15779, B-16113, B-16498, B-16535, B-16747, B-16807, B-16842, B-17177, B-17266, B-17293, B-17403, B-17409, B-17635, B-17636, B-17637, B-18050, B-18140, B-18169, B-19218, B-19363, B-19493, B-19850, B-20238, B-20628, B-20709, B-20824, B-21031, B-21220, B-21294, B-21677, B-21888, B-22061, B-22353, B-22357, B-22400, B-22435, B-22518, B-22522, B-22525, B-22988, B-23002, B-23008, B-23117, B-23371, B-23456, B-23493, B-23538, B-23836, B-23885, B-23901, B-23967, B-24065, B-24079, B-24090, B-24197, B-24380, B-24743, B-24810, B-25017, B-25085, B-25379, B-25479, B-25858, B-25950, B-25977, B-26002, B-26014, B-26057, B-26087, B-26128, B-26172, B-26173, B-26176, B-26254, B-26567, B-26568, B-26618, B-26730, B-26731, B-26778, B-26843, B-26908, B-26944, B-27154, B-27288, B-27357, B-27541, B-27548, B-27605, B-27719, B-27732, B-27818, B-28108, B-28118, B-28146, B-29251, B-29278, B-29363, B-29601, B-29628, B-29745, B-29761, B-30062, B-30124, B-30339, B-30350, B-30530, B-30738, B-30773, B-30943, B-31062, B-31072, B-31091, B-31167, B-31178, B-31223, B-31301, B-31302, B-31400, B-31453, B-31463, B-31472, B-31631, B-31700, B-31790, B-31794, B-32057, B-32099, B-32119, B-32166, B-32302, B-32497, B-32498, B-32615, B-32634, B-32646, B-32681, B-32682, B-32768, B-32781, B-32797, B-32798, B-32799, B-32847, B-32900, B-32937, B-32956, B-33003, B-33073, B-33077, B-33120, B-33398, B-33617, B-33793, B-33816, B-33854, B-34385, B-34679, B-34868, B-35554, B-35566, B-35595, B-35609, B-35660, B-35803, C-00178, C-00965, C-01289, C-03354, C-03789, C-04117, C-04883, C-05614, C-05898, C-06381, C-06526, C-07214, C-08066, C-08354, C-08355, C-08356, C-08357, C-08358, C-08678, C-09620, C-09648, C-09657, C-09660, C-10534, C-15287, C-16134, C-17628, C-19051, C-20192, C-20460, C-20538, C-21859, C-22431, C-22958, C-23106, C-24429, C-25466, C-26966, C-27355, C-27791, C-29726, C-30689, C-30811, C-31924, C-32467, C-32880, C-33577, C-34047, C-34863, C-35949, C-35956, D-00209, D-00373, D-00690, D-00751, D-01949, D-02212, D-02331, D-02339, D-03001, D-03017, D-03418, D-03431, D-03459, D-03506, D-03514, D-06535, D-07572, D-09590, D-09592, D-12648, D-16062, D-16635, D-16636, D-17630, D-20355, D-23098, D-23149, D-23152, D-23411, D-25780, D-25996, D-27255, D-29349, D-29973, D-31371, D-31760, D-33108, D-33539, D-33723, E-26550, F-01784, F-10308, F-12662, F-16828, F-25761, G-00208, G-00715, G-03788, G-05942, G-21125, G-34667, I-05463, I-19325, I-24187, J-16457, J-34518, K-07766, K-15926, K-20194, K-21083, K-21084, K-31516, L-00054, L-00871, L-00973, L-01528, L-02840, L-03540, L-04942, L-06732, L-07235, L-07781, L-09604, L-09677, L-10567, L-12511, L-14028, L-14798, L-14932, L-15554, L-15688, L-19059, L-22343, L-23754, L-27184, L-27185, L-29679, L-29813, L-29975, L-30149, L-30688, L-31084, L-31465, L-32171, L-32352, L-32382, L-32383, L-32626, L-32796, L-32893, L-33117, L-34033, L-34256, M-00376, M-00844, M-08698, M-13980, M-14491, M-15760, M-27680, M-30896, M-31071, N-01539, N-03438, N-19060, N-32254

INERTIAL SEPARATION B-07429, B-31945

INFECTIOUS DISEASES A-00402, L-03198

INFRARED RADIATION B-03966, B-22538, C-03010, C-23004

INFRARED SPECTROMETRY A-03825, A-05549, A-08373, A-19814, A-23843, B-06363, C-02786, C-03542, C-05426, C-07214, C-08066, C-20100, C-20192, C-20264, C-24814, C-29337, C-29843, C-34279, D-00251, D-00373, F-14987, F-19061, F-19063, G-00177

INGESTION A-00402

INORGANIC ACIDS A-30218, A-32855, B-00975, B-03129, B-04943, B-05332, B-06106, B-07531, B-09784, B-09839, B-26254, B-29363, B-30350, B-31091, B-31233, B-32119, C-03010, C-11123, C-20460, C-23107, C-31924, D-09590, D-25996, D-29973, D-31371, D-33108, D-35764, E-19849, F-23187, G-05942, G-05946, G-21125, G-35570, I-19325, K-07766, K-31516, L-27677, L-32354, L-32382
INSPECTION A-27821, B-00504, B-01672, B-06280, B-32956, L-03198, L-09215, L-14932, L-28348, L-29679, L-33672, L-34926
INSPECTORS A-27669, B-00975, C-08678, N-01539
INSTRUCTORS B-00975
INSTRUMENTATION A-00393, B-00257, B-00286, B-00379, B-00975, B-01867, B-02794, B-05808, B-08360, B-09656, B-09661, C-00178, C-02786, C-03010, C-04883, C-05426, C-08354, C-08355, C-08356, C-08357, C-08358, C-08678, C-08953, C-09364, C-09521, C-09620, C-09648, C-10593, C-12665, C-13367, C-23004, C-29726, C-29843, C-32676, C-35240, C-35956, D-00251, L-10484, L-31465, L-34926, N-05235
INTERMITTENT MONITORING D-23845
INTERNAL COMBUSTION ENGINES A-00393, A-01565, A-05007, A-05335, A-05527, A-05549, A-05608, A-06039, A-08802, A-09255, A-11692, A-12377, A-12505, A-14116, A-14297, A-14914, A-15297, A-20101, A-20118, A-20134, A-20553, A-20557, A-21700, A-25327, A-25455, A-26048, A-27129, A-27249, A-27986, A-28352, A-30603, A-30851, A-31759, A-32653, A-33564, A-33648, A-33719, A-34018, A-34766, A-34891, A-34964, A-35590, A-35635, B-00504, B-01613, B-01867, B-05490, B-06280, B-06453, B-06525, B-06636, B-06979, B-07224, B-07479, B-07971, B-08497, B-08604, B-08663, B-09608, B-11220, B-11234, B-12133, B-17906, B-20120, B-20877, B-20878, B-21220, B-23067, B-24845, B-24988, B-29437, B-29533, B-30865, B-31167, B-31400, B-31631, C-02786, C-03542, C-05170, C-07266, C-14606, C-14607, C-14680, C-16442, C-16781, C-20100, C-21693, C-22448, C-26966, C-27121, C-27934, C-29337, C-31924, D-00241, D-00251, D-18231, D-24162, G-21125, G-34667, K-00157, K-07766, K-16263, L-00054, L-03198, L-04841, L-04888, L-05129, L-09215, L-09677, L-12376, L-35511, M-23408
INTERNATIONAL A-31882, B-06280, K-35146, L-12376
INVERSION A-03097, A-05007, A-14972, A-16058, A-31759, B-00975, B-01672, B-26087, C-25065, D-03017, D-03431, D-09590, D-09592, D-12426, L-02840, L-07235, M-08698, N-03438
IODIMETRIC METHODS A-17603, B-02279, B-03807, C-08355, C-08358, C-09619, C-27248, C-35956
IODINATED HYDROCARBONS C-08066
IONIZATION A-01885, B-21006, B-26296, C-08357, F-01784
IONIZATION CHAMBERS C-08357
IONS B-16365, B-33122, F-01784, F-11132, F-19102
IRON A-32489, B-04227, B-09784, B-09836, B-10277, B-28756, D-09590, D-09592, D-29973, I-24187, L-00973, L-01604, L-29813, L-29975, L-31084
IRON COMPOUNDS D-31371, F-11132, I-05463
IRON OXIDES A-28614, B-28146, B-28756

IRRADIATION CHAMBERS A-05007, B-25224
ISOPENTANES G-00177
ISOTOPES F-14987, N-03438
ITALY B-04773, B-23319, B-26176

J

JAPAN A-06240, A-16135, A-16494, A-17198, A-17236, A-17462, A-17631, A-17632, A-17633, A-17634, A-19899, A-20706, A-21661, A-21857, A-22987, A-23000, A-24500, A-25056, A-26048, A-26574, A-26575, A-26605, A-26826, A-27669, A-27972, A-28295, A-28527, A-28614, A-29332, A-29455, A-29599, A-29842, A-30513, A-30687, A-31044, A-31155, A-31157, A-31263, A-32475, A-32855, A-32878, A-32879, B-03976, B-04664, B-08104, B-12480, B-12482, B-13072, B-14203, B-14488, B-14940, B-14951, B-14956, B-15170, B-15772, B-15948, B-16535, B-17238, B-17293, B-17314, B-17395, B-17403, B-17635, B-17636, B-17637, B-19218, B-20625, B-20628, B-20709, B-21647, B-22061, B-22538, B-22988, B-23002, B-23117, B-24380, B-24845, B-25379, B-26002, B-26014, B-26056, B-26057, B-26125, B-26128, B-26296, B-26308, B-26567, B-26568, B-26618, B-26836, B-26843, B-27288, B-27541, B-27548, B-27674, B-28146, B-28756, B-29131, B-29437, B-29448, B-29533, B-29601, B-29745, B-29761, B-29978, B-30260, B-30479, B-30530, B-30782, B-31091, B-31160, B-31223, B-31233, B-31354, B-31456, B-31911, B-31945, B-32099, B-32119, B-32497, B-32498, B-32768, B-32797, B-32798, B-32799, B-32847, B-32900, B-32913, B-33003, B-33120, B-33122, B-33380, B-33398, B-33617, B-33742, B-34073, B-35803, C-06112, C-12479, C-12487, C-12488, C-12492, C-13627, C-16134, C-16540, C-17288, C-17290, C-17627, C-17628, C-17629, C-17638, C-17639, C-17640, C-17641, C-20202, C-20264, C-20460, C-20624, C-21208, C-21858, C-21859, C-21866, C-22431, C-23004, C-23106, C-23107, C-24814, C-26309, C-26547, C-26837, C-27355, C-27475, C-27685, C-27791, C-28787, C-29337, C-29508, C-29726, C-29843, C-29929, C-30374, C-30689, C-30704, C-30811, C-31222, C-31924, C-32467, C-32795, C-32880, C-33121, C-33349, C-33577, C-34047, C-34279, C-35751, D-17630, D-20355, D-23098, D-23149, D-23152, D-25291, D-26304, D-27255, D-29349, D-29973, D-31371, D-33108, D-33723, D-35764, F-11132, F-12449, F-13107, F-19102, F-22429, F-22430, F-26529, F-29649, G-28175, I-05463, I-19325, K-31968, K-35146, L-14932, L-15691, L-17258, L-27184, L-27185, L-27677, L-27678, L-27679, L-28348, L-28363, L-29679, L-29813, L-29975, L-30149, L-30153, L-30688, L-32796, L-32893, L-33117, L-33725, L-35511, L-35752, M-13980, M-14491, M-27680, M-30896
JET AIRCRAFT A-05549, A-27451, A-32653, B-08663, C-31924, D-01202

K

KANSAS C-11167, D-03418
KENTUCKY D-31760, L-09677, L-32626, L-34755
KEROSENE B-06979, B-11220, C-27121, D-00251
KETONES A-29698, A-32855, A-33713, A-33983, A-34964, B-04627, B-05409, B-16842, B-16890, B-19493, B-21294, B-24969, B-27674, B-32166, C-03354, C-07214, C-08066, C-08356, C-08357, C-10983, C-11123, C-13749, C-14607, C-27934, C-32269, G-00177, K-05947
KIDNEYS G-35671
KILNS A-08359, A-25205, A-29599, A-34228, A-35564, B-02279, B-03976, B-07434, B-07875, B-08360, B-11008, B-11059, B-11158, B-13551, B-15709, B-15779, B-16842, B-17409, B-17635, B-17636, B-20709, B-20824, B-23002, B-24065, B-27541, B-32615, B-32681, B-32956, B-35660, C-35956, D-03017, D-09592, D-16062, J-16457, L-00054, L-04942, L-07235, L-09677
KRAFT PULPING A-00525, A-01885, A-04879, A-04893, A-06240, A-06981, A-08359, A-11144, A-12507, A-12621, A-12832, A-12834, A-14580, A-16494, A-17603, A-17633, A-19899, A-24903, A-25205, A-28885, A-30701, A-32475, A-32879, A-33983, A-35581, B-00025, B-00552, B-01549, B-01563, B-01672, B-01900, B-02018, B-02279, B-03129, B-03807, B-03946, B-04045, B-04773, B-04781, B-04783, B-04861, B-04882, B-04887, B-04950, B-04951, B-04952, B-04953, B-05332, B-05408, B-05409, B-05808, B-05880, B-06106, B-06859, B-07415, B-07434, B-08360, B-08361, B-08364, B-08467, B-09508, B-09655, B-09656, B-09661, B-09733, B-09933, B-10277, B-10994, B-11008, B-11009, B-11153, B-11158, B-11673, B-12506, B-12658, B-13072, B-13398, B-13551, B-13772, B-14094, B-14113, B-14118, B-14940, B-15690, B-15709, B-15779, B-16747, B-16807, B-16842, B-17177, B-17266, B-17409, B-18140, B-19218, B-20258, B-20824, B-21051, B-22061, B-22357, B-22522, B-23117, B-23538, B-23901, B-24079, B-25950, B-25977, B-26172, B-26173, B-26176, B-26254, B-27288, B-27357, B-29278, B-29628, B-30062, B-30339, B-31072, B-31463, B-31790, B-31794, B-32615, B-32681, B-32798, B-32937, B-33073, B-34385, B-34868, B-35660, B-35803, C-00965, C-03789, C-04883, C-06526, C-07214, C-08354, C-08355, C-08356, C-08357, C-08358, C-09648, C-09657, C-09660, C-21859, C-22958, C-23106, C-25466, C-27355, C-29726, C-32467, C-32880, C-34863, C-35956, D-00209, D-00690, D-00751, D-03017, D-03506, D-06535, D-07572, D-09592, D-16062, D-33108, F-01784, F-10308, F-12662, F-16828, G-03788, G-34667, J-16457, L-00054,

L-03540, L-06732, L-30149, L-31465, L-32796, L-32893, M-00844, M-08698, M-13980

L

LABORATORY ANIMALS B-02427, B-03297, C-02786, C-03542, C-12359, C-23755, C-32467, D-00751, F-19102, G-00177, G-00208, G-00715, G-05949, G-07821, G-19599, G-21359, G-23298, G-35671, H-00252, K-05947, K-20194, K-21084, M-00844, M-01069, N-03438
LABORATORY FACILITIES A-06981, A-08359, A-35673, C-03010, C-09648, C-17290, G-09659, L-03198, L-04841
LAChRYMATION A-17603, B-19493, D-25780
LACQUERS A-23843, A-34585, B-21294, B-31301, B-31472, C-28393
LAKES B-01672
LANDFILLS A-11651, A-23313, A-23314, A-29353, B-30124, B-30773, D-03017
LAPSE CONDITION C-08066
LARYNX M-00376
LAUNDRIES L-19059
LEAD A-01565, A-26402, B-30124, G-00177
LEAD ALLOYS A-26402
LEAD COMPOUNDS A-01565, A-24459, A-27249, A-30513, A-30603, A-31323, A-34018, B-08663, B-17906, B-28108, B-29628, B-30124, C-05426, C-06112, C-09476, D-24162, G-00177, K-18294, L-07235, L-34033
LEAD PEROXIDE CANDLE C-05503, D-03001, D-09590, D-25291, L-01604
LEATHER A-17634, B-09840
LEAVES A-19814, B-09407, B-17637, D-09590
LEGAL ASPECTS A-01565, A-03097, A-08912, A-20134, A-23313, A-23314, A-24350, A-25179, A-25205, A-25638, A-26911, A-27821, A-29353, A-31323, A-34585, A-35581, B-00504, B-00975, B-01505, B-01672, B-02794, B-03129, B-06280, B-09784, B-10277, B-16890, B-24743, B-25479, B-26057, B-26087, B-27732, B-29628, B-30260, B-31062, B-31453, B-32559, B-33854, C-03010, C-08678, C-25054, C-30374, C-32022, D-01949, D-03001, D-03431, D-25291, D-29973, D-33539, D-33723, D-35764, F-25761, G-06323, K-07766, K-11734, K-15926, K-21084, K-31286, K-31516, L-00054, L-00549, L-00973, L-01528, L-01604, L-02294, L-02295, L-02840, L-06732, L-07235, L-07781, L-09215, L-09604, L-09677, L-10567, L-12376, L-12511, L-14028, L-14616, L-14932, L-15554, L-15688, L-15691, L-16330, L-17258, L-19059, L-23754, L-25446, L-26940, L-27184, L-27185, L-27677, L-27678, L-27679, L-28363, L-29679, L-29813, L-30149, L-30688, L-31084, L-31465, L-32147, L-32171, L-32352, L-32354, L-32382, L-32383, L-32566, L-32626, L-32796, L-32893, L-33117, L-33672, L-33725, L-34033, L-34256, L-34755, L-35694, L-35752, M-00487, M-08698, M-24091, N-03438
LEGISLATION A-01565, A-20134, A-25205, A-29353, A-31323, A-35581, B-00504, B-00975, B-01672, B-02794, B-03129, B-16890, B-24743, B-25479, B-29628, B-30260, C-30374, C-32022, D-01949, D-25291, D-29973, D-33539, D-33723, D-35764, K-11734, K-31286, K-31516, L-00054, L-00549, L-00973, L-02294, L-02295, L-09677, L-12376, L-23754, L-25446, L-27185, L-29679, L-29813, L-30688, L-31084, L-31465, L-32147, L-32352, L-32626, L-32796, L-32893, L-33117, L-33672, L-33725, L-34033, L-34256, L-34755, L-35694, L-35752, M-00487, M-08698, M-24091, N-03438
LIGHT RADIATION A-05007, A-25179, B-01352, B-03966, B-05624, B-09836, B-21006, B-22538, B-25224, B-27674, C-03010, C-21652, C-23004, C-35182, D-01202, D-31760, G-00177, G-11476
LIGHT SCATTERING A-32653, B-05532
LIME A-08359, A-29599, A-35564, B-02279, B-07434, B-08360, B-11008, B-13551, B-15709, B-15779, B-16842, B-17409, B-32615, B-32681, C-35956, D-03017, D-09592, D-16062, J-16457, L-00054, L-04942, L-07235
LIMESTONE B-14671, B-30350, B-32646, B-34073
LIPIDS G-05946
LIQUIDS A-09175, A-14580, A-20276, A-21395, A-26574, A-27972, A-29455, A-34228, B-02427, B-04949, B-04952, B-04953, B-05532, B-06103, B-09794, B-09836, B-09839, B-09840, B-09842, B-15779, B-16365, B-25017, B-25224, B-26125, B-29533, B-30773, B-31091, C-08354, C-10016, C-27475, C-28787, F-16696, I-05463
LITHIUM COMPOUNDS A-03825, B-11234, D-00373, F-11132, L-35511
LITIGATION L-23754, L-27185, L-32147, L-34033, L-35694
LOCAL GOVERNMENTS B-00975, B-26057, C-11167, D-35764, K-15926, L-00871, L-09677, L-12511, L-15554, L-27185, L-33117, L-33725, L-35694, N-03438
LONDON B-05624
LOS ANGELES A-24527, A-32653, B-00975, B-06412, B-09784, B-09842, B-14341, B-16890, B-26057, B-32559, C-03010, K-00157, L-00549, L-00973, L-09677
LOUISIANA B-08364
LOWER ATMOSPHERE B-31223, L-32566

LUBRICANTS A-34766, B-09857, B-32956

LUNG CANCER A-22973, L-34256
LUNGS G-07821, G-23298, G-35671, H-00252

M

MAGNESIUM G-05942
MAGNESIUM COMPOUNDS F-11132, I-05463
MAINE B-07434
MAINTENANCE A-02001, A-05527, A-08802, A-27821, A-31155, A-31880, A-33883, B-00504, B-01672, B-06280, B-07415, B-08497, B-09840, B-09842, B-20824, B-21220, B-23067, B-24845, B-25858, B-28108, B-31631, B-32498, B-33077, B-35595, D-02212, I-24187, L-34926, M-30896
MALES C-08268, D-00751, M-00844, M-01069
MANAGEMENT PERSONNEL M-31071
MANGANESE F-11132, G-00177
MANGANESE COMPOUNDS A-08912, B-03297, B-04627, B-11234, B-32166, B-32646, F-11132, G-00177
MANGANESE DIOXIDE (JAPANESE) B-06636
MAPPING D-26304, D-33539, L-32354
MARYLAND A-11700, A-12832, A-12834, A-23313, A-23314, A-29698, B-02794, D-23411, L-09604, L-23754, L-32626
MASS SPECTROMETRY A-05549, A-11692, A-19814, A-21978, A-25455, A-33564, A-34766, A-34964, C-03354, C-07214, C-08066, C-10534, C-14607, C-27121, C-27685, C-28787, C-29843, C-35956, F-07681, F-19063
MASSACHUSETTS B-31453
MATERIALS DETERIORATION A-03097, A-16058, A-17603, A-22973, A-33828, A-34018, A-34287, B-00975, B-01505, B-02018, B-04227, B-10277, B-19218, B-26172, B-29323, B-31790, C-08066, D-01949, D-03017, D-03514, D-06535, D-09590, D-09592, D-25996, D-26304, D-31760, D-35764, E-19849, G-35570, I-05463, I-19325, I-24187, L-00054, L-00871, L-01604, M-26725, N-03438, N-19060
MATHEMATICAL ANALYSES A-03097, A-28861, A-31759, A-33828, A-35590, A-35638, B-26730, B-31211, C-03010, C-08355, C-10693, C-21652, C-22958, C-26096, C-27248, C-29269, C-32676, C-34047, F-16455, F-22429, F-35651, L-05129
MATHEMATICAL MODELING A-33828, B-26730, B-31211, C-10693, C-27248
MAXIMUM ALLOWABLE CONCENTRATION A-23843, A-25638, A-32878, A-33719, B-00975, B-03129, B-09922, C-02786, D-01202, D-05256, D-16635, D-16636, G-05942, G-05943, G-05946, G-05949, G-07821, G-21125, G-35570, K-05117, K-05947, K-07766, K-11734, K-20194, K-21083, K-21084, K-27403, K-30870, K-31516, K-35146, L-00549, L-00871, L-00973, L-09677, L-15688, L-32382, L-32383, L-33117
MBTH METHOD A-05549
MEASUREMENT METHODS A-02001, A-03825, A-04785, A-04860, A-05549, A-07089, A-08373, A-10075, A-15297, A-17631, A-17632, A-19899, A-20134, A-20553, A-20557, A-20706, A-21661, A-21857, A-23843, A-24350, A-25228, A-25455, A-26605, A-26826, A-29599, A-29698, A-30218, A-30701, A-30851, A-31044, A-31155, A-31263, A-31323, A-32475, A-32855, A-33713, A-34891, A-34964, A-35581, A-35622, A-35635, B-00032, B-00975, B-01414, B-01672, B-03946, B-03966, B-04045, B-04361, B-04533, B-05490, B-05532, B-06106, B-06280, B-06453, B-06979, B-07224, B-08350, B-08506, B-08604, B-09608, B-09784, B-10005, B-10009, B-11136, B-11843, B-12480, B-13971, B-14013, B-14967, B-20120, B-20877, B-20878, B-23008, B-23319, B-23371, B-23885, B-24380, B-24988, B-25594, B-25950, B-27288, B-27793, B-28118, B-29448, B-29877, B-30260, B-30809, B-31302, B-32099, B-32646, B-32681, B-32797, B-32798, B-34868, B-35879, C-00178, C-03010, C-03354, C-03789, C-04117,

C-05170, C-05396, C-05426, C-05503, C-05614, C-05813, C-05898, C-06112, C-06381, C-07266, C-08066, C-08678, C-08953, C-09364, C-09476, C-09521, C-09619, C-09620, C-09648, C-09657, C-09660, C-09716, C-09860, C-10016, C-10029, C-10534, C-10593, C-10693, C-10983, C-11167, C-11486, C-12359, C-12479, C-12487, C-12492, C-12665, C-12942, C-13367, C-13627, C-13749, C-13969, C-14108, C-14109, C-14606, C-15677, C-16080, C-16442, C-16540, C-16754, C-16781, C-17044, C-17288, C-17290, C-17638, C-17639, C-17640, C-17641, C-18093, C-18194, C-19051, C-20100, C-20264, C-20538, C-20624, C-21208, C-21652, C-21693, C-21358, C-21866, C-22431, C-22448, C-22958, C-23004, C-23106, C-23107, C-23755, C-24071, C-24429, C-24814, C-25054, C-25065, C-25466, C-26096, C-26309, C-26837, C-26966, C-27121, C-27248, C-27355, C-27475, C-27685, C-27733, C-27791, C-27934, C-28141, C-28393, C-28787, C-29243, C-29269, C-29337, C-29508, C-29726, C-29843, C-29858, C-29891, C-29929, C-30374, C-30689, C-30811, C-31222, C-31924, C-32022, C-32268, C-32269, C-32467, C-32676, C-32795, C-32880, C-33121, C-33349, C-33577, C-34047, C-34178, C-34279, C-34972, C-35182, C-35240, C-35541, C-35648, C-35751, C-35865, C-35949, C-35956, D-00251, D-00373, D-00690, D-03001, D-03514, D-05481, D-07572, D-09590, D-16062, D-17630, D-18231, D-20355, D-23098, D-23149, D-23152, D-23845, D-24162, D-25291, D-25996, D-29349, D-29973, D-31371, D-33723, F-11132, F-13107, F-13670, F-19061, F-19063, F-19102, F-22429, F-29649, F-32271, F-33084, F-35651, G-00177, G-00715, G-05942, G-05943, G-05946, G-05949, G-06323, G-09659, G-19599, G-20969, G-21359, G-34667, G-34686, G-35671, K-05947, K-11734, K-20194, K-21083, K-21084, K-31286, K-31968, L-01604, L-03198, L-03540, L-04841, L-04888, L-04942, L-07235, L-10484, L-14616, L-25446, L-27677, L-28348, L-30149, L-31465, L-32147, L-32352, L-32354, L-32566, L-33672, L-34926, L-35511, L-35752, M-00487, M-23408, M-26725, M-30896, N-19088, N-20495

MEDICAL FACILITIES L-30153, L-30688

MEDICAL PERSONNEL L-07235, L-30688

MEETINGS D-23149, D-23152, M-08698

MEMBRANE FILTERS B-03966, B-32799, C-06526, C-09619, D-00251, G-00177, I-05463

MEMBRANES C-34972, F-22430, F-32271, G-35570

MERCAPTANS A-01644, A-01885, A-04893, A-08359, A-11144, A-12507, A-14580, A-16494, A-17198, A-17631, A-17633, A-19899, A-20134, A-21857, A-24903, A-28527, A-29599, A-29842, A-31044, A-31263, A-32475, A-32879, B-00025, B-00286, B-00379, B-01414, B-01505, B-01508, B-01563, B-01672, B-01900, B-02018, B-02427, B-02488, B-03807, B-04045, B-04627, B-04838, B-04861, B-04882, B-04887, B-04950, B-04951, B-04952, B-04953, B-05408, B-05409, B-05808, B-06106, B-07434, B-07531, B-08360, B-08361, B-08364, B-08467, B-09508, B-09655, B-09661, B-09854, B-09922, B-10277, B-10994, B-11008, B-13072, B-14113, B-14488, B-14692, B-15779, B-16842, B-17266, B-17293, B-19218, B-19850, B-20625, B-22400, B-22838, B-23538, B-24380, B-25224, B-26014, B-26176, B-26254, B-26908, B-27674, B-29278, B-29745, B-31302, B-31790, B-32099, B-32615, B-32681, B-32798, B-32956, B-35595, B-35803, C-00965, C-01289, C-04883, C-05426, C-06381, C-08066, C-08354, C-08355, C-08356, C-08357, C-08358, C-09619, C-09648, C-09657, C-10983, C-11123, C-13749, C-14108, C-17629, C-17639, C-17640, C-19051, C-20202, C-21858, C-21859, C-23004, C-24071, C-24814, C-26547, C-27355, C-27685, C-27934, C-29243, C-29726, C-30704, C-30811, C-31924, C-32467, C-32880, C-33349, C-34279, C-34863, C-35865, C-35956, D-00209, D-09592, D-16062, D-29349, D-31371, D-33723, F-01784, F-10308, F-12662, F-16828, F-29649, G-00208, G-03788, G-09659, L-00054, L-32796, L-32893, L-33725, M-08698, M-27680, N-19060

MERCURY COMPOUNDS C-31222, D-31371

METABOLISM A-26911, F-11132, G-05949, L-03198

METAL COMPOUNDS A-01565, A-03825, A-06240, A-08912, A-11144, A-24459, A-24903, A-25205, A-27249, A-30513, A-30603, A-31323, A-32489, A-33828, A-34018, A-34287, A-34891, A-35590, B-00025, B-00379, B-00571, B-03297, B-03499, B-03972, B-04627, B-04666, B-04783, B-04838, B-04887, B-04943, B-04953, B-05808, B-06106, B-06363, B-07531, B-08360, B-08364, B-08663, B-09655, B-09784, B-09839, B-09849, B-10277, B-11008, B-11009, B-11220, B-11234, B-14671, B-16365, B-16747, B-17906, B-20369, B-23538, B-24743, B-24845, B-27401, B-28108, B-28146, B-28756, B-29251, B-29628, B-30124, B-30339, B-30350, B-30530, B-31072, B-31790, B-32070, B-32166, B-32615, B-32646, B-32847, B-32935, B-34073, B-34385, C-01289, C-05426, C-06112, C-08356, C-08358, C-09476, C-09619, C-09657, C-27248, C-31222, D-00373, D-09590, D-09592, D-23845, D-24162, D-29973, D-31371, F-11132, F-13107, G-00177, I-05463, K-18294, K-31968, L-04888, L-07235, L-27677, L-34033, L-35511

METAL FABRICATING AND FINISHING A-19366, A-20553, A-28614, A-32465, A-32489, B-00975, B-08506, B-09784, B-09791, B-09830, B-18050, B-19363, B-23493, B-23967, B-26254, B-26843, B-27732, B-30943, B-31178, B-31223, C-26966, D-03431, D-33108, L-01528, L-07235, L-27185, L-29975

METAL POISONING K-31968

METALS A-01565, A-10699, A-26402, A-32489, A-34018, A-34287, B-03129, B-03499, B-04227, B-05929, B-07362, B-09784, B-09791, B-09819, B-09830, B-09836, B-09840, B-10277, B-14609, B-27154, B-28206, B-28756, B-30124, B-31400, B-33742, B-33816, C-08066, D-03514, D-09590, D-09592, D-29973, D-33108, F-11132, G-00177, G-05942, I-24187, L-00973, L-01604, L-29813, L-29975, L-31084

METEOROLOGICAL INSTRUMENTS A-03097, C-00178, C-03010, C-35956, D-09592, E-14906

METEOROLOGY A-02765, A-03097, A-05007, A-06240, A-10075, A-11700, A-12832, A-12834, A-14972, A-20706, A-23313, A-24500, A-26911, A-29353, A-29599, A-30218, A-30513, A-31263, A-31759, A-33628, A-34290, A-35564, A-35581, A-35622, A-35693, B-00358, B-00975, B-01508, B-01672, B-02047, B-02794, B-03975, B-04882, B-05490, B-09836, B-16712, B-16842, B-23371, B-26087, B-27288, B-32070, B-32900, B-35955, C-00178, C-08066, C-08358, C-08678, C-09660, C-11167, C-21208, C-25065, C-25466, C-26966, C-35956, D-00690, D-01202, D-01949, D-02331, D-02339, D-03001, D-03017, D-03418, D-03431, D-03459, D-03506, D-03514, D-06535, D-09590, D-09592, D-12648, D-23098, D-23149, D-23152, D-23845, D-25996, D-27255, D-31371, D-31760, D-33108, D-33539, D-33723, E-14906, G-00177, G-06323, I-05463, L-00054, L-01604, L-02840, L-04888, L-07235, L-14616, L-29813, L-32352, L-32566, L-34256, L-34926, M-00376, M-00487, M-08698, M-26725, M-27680, N-03438, N-19088

METHANES A-01885, A-16494, A-29599, A-32411, A-34964, A-35564, B-00379, B-01508, B-04838, B-09655, B-29978, B-32956, C-07214, C-08354, C-10693, C-24814, C-30704, F-16828, N-20495

MICE G-07821

MICHIGAN A-16058, L-00973, L-07781, L-09677

MICROMETEOROLOGY D-33108, D-33539, D-33723

MICROORGANISMS A-04785, A-21661, A-31602, A-35599, A-35673, B-01508, B-03297, B-04666, B-06688, B-20754, B-21006, B-22538, B-22550, B-27336, B-31233, B-31354, B-33398, C-13143, C-21208, C-35956, D-31760, F-26529, G-07091, G-07821

MICROSCOPY C-23755

MINERAL PROCESSING A-29842, A-32465, A-33719, A-34018, B-00975, B-03972, B-03976, B-04627, B-07875, B-08467, B-14940, B-21220, B-26254, B-31400, B-32302, C-25466, D-03431, D-09592, D-16636, D-23411, K-15926, K-31516, L-09677, L-15554, L-32626

MINERAL PRODUCTS B-00975, B-09784, B-09840, B-14671, B-20369, B-21938, B-26254, B-30350, B-32302, B-32646, B-34073, C-27248

MINING B-21220, B-26254, B-31400, D-16636, D-23411, L-32626

MINNESOTA D-02212

MISSILES AND ROCKETS F-07681

MISSISSIPPI D-12426

MISSOURI A-01644, A-01885, A-02001, B-00257, B-00379, B-01414, B-01563, B-02725, B-02729, B-03966, B-03976, B-04045, B-05862, C-03354, C-03789, C-11167, D-02331, D-03418, D-33539, K-07766, L-00973, L-01604, L-09677, L-30149

MISTS B-00025, B-04664, B-04949, B-05930, B-07429, B-07971, B-09813, B-09815, B-09836, B-09840, B-09842, B-09849, B-09852, B-11008, B-13551, B-20817, B-23493, B-24065, B-27818, C-35956, D-05481, D-29973

MOBILE A-32465, B-16842, C-19051, M-23408

MOLYBDENUM I-24187

MONITORING A-15297, A-25228, A-26605, A-29599, A-31155, A-31323, B-01672, B-08360, B-10009, B-25950, B-27793, B-28118, B-32681, B-32798, C-03789, C-05426, C-06112, C-10693, C-12665, C-19051, C-23107, C-27248, C-27733, C-30374, C-32022, C-34279, C-35956, D-00373, D-00690, D-03001, D-16062, D-23152, D-23845, D-24162, D-25291, D-33723, G-00177, G-06323, K-11734, K-31286, L-01604, L-07235, L-25446, L-27677, L-30149, L-31465, L-32147, L-32352, L-32354, L-33672

MONTHLY A-30513, C-08678, D-01949, D-09590, D-23411, D-23845, D-25780, D-27255, D-33723, K-35146, L-32352, N-03438

MORBIDITY G-27137

MORTALITY G-27137, L-34256

MOUNTAINS B-01672, N-03438

MULTIPLE CHAMBER INCINERATORS A-08373, A-10699, A-26575, A-27972, A-29332, A-31155, A-31157, A-34654, A-35383, B-00246, B-09784, B-09827, B-09830, B-14956, B-15170, B-23008, B-23836, B-26568, B-27548, B-33077, B-33793

N

NAPHTHALENES A-07089, A-33564, A-34964, B-14203, B-24969, C-27121, C-32269

NAPHTHENES A-05007, B-07362

NASHVILLE L-19059, M-01069

NATIONAL AIR SAMPLING NETWORK (NASN) N-03438

NATURAL GAS A-17603, A-21395, A-27249, A-28352, A-31759, B-09922, B-22838, B-25479, B-33793, C-14108, D-03431, D-09590, D-09592, G-00715, L-32352

NAUSEA A-20553, A-30687, B-01672, D-02339, G-07821, G-28175

NERVOUS SYSTEM A-17603, A-31759, C-12359, C-29269, C-32269, C-34972, F-11132, F-22430, F-32271, G-05942, G-05946, G-05949, G-06323, G-21359, G-21712, G-35671, K-05947, K-20194, K-21084, N-05235

NEVADA L-32171, L-32383

NEW HAMPSHIRE D-03017

NEW JERSEY B-09729, L-00973, L-09677

NEW YORK CITY A-27821, L-00973, L-09677

NEW YORK STATE A-27821, B-01672, D-01202, L-00973, L-04942, L-09677

NICKEL B-33742, F-11132, I-24187

NICKEL COMPOUNDS F-11132

NITRATES L-04666, B-06636, C-34279, D-09590, D-23845, E-19849

NITRIC ACID B-03129, B-26254, G-21125, I-19325

NITRIC OXIDE (NO) A-01565, A-05007, A-05527, A-05549, A-08802, A-27451, A-30513, A-34891, B-00975, B-04627, B-06280, B-06636, B-08497, B-08663, B-20878, C-03542, C-09476, C-29337, D-00251, D-05481, D-29973, F-07681, G-00177, L-01604, L-35511, N-20495

NITRILES B-14692, B-27674, C-03354, C-11123, F-17801

NITRITES C-10693

NITROGEN A-17198, A-29599, A-32411, A-32489, A-35673, B-07224, B-27674, B-32119, C-03010, C-08354, C-27685, F-26529

NITROGEN DIOXIDE (NO2) A-01565, A-02001, A-05007, A-05527, A-07561, A-08802, A-09175, A-30513, A-31759, A-33828, B-00975, B-04361, B-06280, B-08497, B-20878, B-21220, B-29437, C-02786, C-03542, C-09476, C-16781, C-27733, D-00241, D-00251, D-01949, D-03001, D-05481, D-25996, D-27255, D-29973, D-31760, G-00177, G-34686, K-11734, K-21918, K-27403, K-31968, K-35146, L-01604, L-03198, L-27678, L-27679, N-03438, N-19060, N-20495

NITROGEN OXIDES A-01565, A-02001, A-05007, A-05527, A-05549, A-06039, A-07561, A-08802, A-09175, A-09255, A-12377, A-14116, A-14297, A-20101, A-20125, A-20134, A-24459, A-26048, A-26911, A-27129, A-27249, A-27451, A-28352, A-30513, A-31323, A-31759, A-31880, A-31882, A-32465, A-32653, A-32855, A-33719, A-33828, A-34018, A-34891, A-3563[illegible], B-00504, B-00975, B-01508, B-01867, B-04300, B-04361, B-04627, B-06280, B-06636, B-07875, B-07971, B-08497, B-08663, B-09784, B-09827, B-09830, B-11234, B-14967, B-16365, B-17906, B-19705, B-20878, B-21220, B-23008, B-24845, B-24988, B-29437, B-29533, B-30865, B-31062, B-31354, B-31400, B-33077, C-02786, C-03010, C-03542, C-05170, C-06112, C-07266, C-09476, C-16781, C-20100, C-23107, C-27248, C-27733, C-29337, C-29843, C-30014, C-34279, C-35956, D-00241, D-00251, D-01949, D-03001, D-03506, D-03514, D-05481, D-06535, D-09592, D-24162, D-25996, D-26304, D-27255, D-29973, D-31371, D-31760, D-33539, D-35764, E-19849, F-07681, G-00177, G-21125, G-34686, I-19325, K-00157, K-11734, K-16263, K-18294, K-21918, K-27403, K-31968, K-35146, L-00054, L-01604, L-02840, L-03198, L-04888, L-09677, L-27678, L-27679, L-32147, L-34926, L-35511, M-24091, N-03438, N-19060, N-20495

NITROGEN TRIOXIDE (NO3) C-09476, D-31760

NITROSO C-10693

NITROUS OXIDE (N2O) B-01867, B-24845

NON-INDUSTRIAL EMISSION SOURCES A-00525, A-02001, A-03097, A-04785, A-05608, A-07089, A-07561, A-08373, A-08802, A-09175, A-09255, A-10075, A-11651, A-12083, A-12832, A-12834, A-16058, A-17236, A-17462, A-17603, A-19814, A-20553, A-22860, A-23313, A-23314, A-24350, A-25056, A-25228, A-25638, A-26574, A-26575, A-26911, A-27821, A-27972, A-29332, A-29353, A-29455, A-29599, A-30389, A-31155, A-31157, A-31602, A-31759, A-32385, A-32411, A-32855, A-33719, A-33883, A-34228, A-34287, A-34290, A-34654, A-35383, A-35564, A-35599, A-35673, A-35693, B-00032, B-00358, B-00541, B-00571, B-00975, B-01508, B-01549, B-01563, B-03129, B-03297, B-03972, B-04361, B-04664, B-04666, B-05852, B-06412, B-06453, B-06688, B-07224, B-07479, B-07971, B-08497, B-08604, B-08663, B-09729, B-09784, B-09827, B-09839, B-09842, B-09922, B-10009, B-13697, B-14609, B-14940, B-14967, B-15948, B-16535, B-17403, B-18153, B-19182, B-19705, B-20754, B-22435, B-22518, B-22538, B-22550, B-22837, B-23008, B-23538, B-23594, B-23836, B-25085, B-25479, B-25554, B-25623, B-25694, B-25977, B-26125, B-26254, B-26778, B-27336, B-27541, B-27605, B-27719, B-27732, B-27818, B-28108, B-28118, B-28146, B-29251, B-29448, B-30124, B-30530, B-30773, B-31302, B-31453, B-31794, B-32119, B-32497, B-32498, B-32615, B-32682, B-32768, B-32900, B-32913, B-32935, B-33003, B-33120, B-33380, B-33793, B-33816, B-33854, B-34073, B-35595, B-35879, C-05170, C-05503, C-08066, C-09620, C-13099, C-13749, C-16781, C-26966, C-27791, C-28141, C-30704, C-31222, C-32022, C-35865, C-35956, D-00373, D-00690, D-00751, D-01949, D-02331, D-02339, D-03017, D-03418, D-03431, D-03506, D-09590, D-09592, D-17630, D-23411, D-25291, D-25780, D-29973, D-31371, D-33108, D-33539, D-33723, D-35764, E-26550, F-07681, F-26529, F-29649, G-03788, H-00252, I-05463, J-16457, J-34518, K-07766, K-31286, K-31516, L-00054, L-00973, L-02840, L-07235, L-09604, L-09677, L-10567, L-14616, L-15688, L-15691, L-17258, L-19059, L-25446, L-27184, L-27185, L-27677, L-27678, L-27679, L-28348, L-28363, L-30153, L-32147, L-32171, L-32354, L-32382, L-32383, L-32626, L-32796, L-33117, L-34033, M-00844, M-24091, N-03438, N-19060, N-32254

NON-URBAN AREAS A-11700, A-12832, A-12834, A-22973, A-26911, A-33713, A-35564, B-04361, B-14453, B-20709, B-22550, B-25858, B-33120, D-29973, H-00252, L-30153, L-30688, M-15760, N-01539

NORTH CAROLINA D-05481, K-31516, N-03438

NOSTRILS A-00402, B-06280, B-31700, C-05898, C-08066, C-08678, C-21693, C-32676, C-34972, F-03173, F-11132, F-35651, G-06323, G-09659, G-20969, G-21359, M-00376, N-05235

NUCLEAR POWER PLANTS A-12832, A-26911, B-28108

NUCLEAR POWER SOURCES D-00373

NUCLEATION B-29533

NYLON D-09590, L-01604

O

OCCUPATIONAL HEALTH G-35570, K-11734, L-29975

ODOR COUNTERACTION A-00393 A-00525, A-04785, A-04860, A-04893, A-05527, A-06981, A-09853, A-11651, A-12083, A-12507, A-12621, A-12993, A-14580, A-17603, A-17632, A-17634, A-19366, A-19899, A-20276, A-20553, A-21661, A-21887, A-22987, A-23000, A-24007, A-24527, A-24903, A-25056, A-25179, A-25205, A-25228, A-25455, A-26402, A-26575, A-26826, A-26911, A-27249, A-27972, A-28352, A-28861, A-29332, A-29455, A-29599, A-29842, A-30389, A-30701, A-30851, A-31155, A-31157, A-31602, A-31882, A-32385, A-32855, A-33188, A-33883, A-34228, A-34654, A-35383, A-35564, A-35581, A-35590, A-35673, B-00025, B-00032, B-00257, B-00286, B-00358, B-00379, B-00541, B-00552, B-00571, B-01352, B-01414, B-01508, B-01537, B-01563, B-01672, B-01867, B-01900, B-02047, B-02427, B-02729, B-03499, B-03807, B-03946, B-03972, B-04045, B-04227, B-04300, B-04627, B-04664, B-04666, B-04669, B-04773, B-04781, B-04783, B-04861, B-04882, B-04887, B-04943, B-04950, B-04951, B-04952, B-04953, B-05093, B-05408, B-05409, B-05624, B-05808, B-05862, B-05929, B-05930, B-06088, B-06103, B-06106, B-06363, B-06366, B-06412, B-07362, B-07434, B-07530, B-07531, B-08104, B-08360, B-08467, B-08506, B-09407, B-09608, B-09656, B-09661, B-09729, B-09733, B-09836, B-09849, B-09854, B-09933, B-10005, B-10588, B-11059, B-11153, B-11158, B-11220, B-11234, B-11673, B-12133, B-12346, B-12434, B-12480, B-12482, B-12506, B-13072, B-13334, B-13772, B-13812, B-13971, B-14004, B-14094, B-14113, B-14341, B-14354, B-14453, B-14488, B-14671, B-14692, B-14757, B-14895, B-14940, B-14956, B-15153, B-15170, B-15709, B-15772, B-15779, B-15948, B-16365, B-16498, B-16535, B-16712, B-16807, B-17177, B-17238, B-17293, B-17395, B-17409, B-17635, B-17636, B-17637, B-18140, B-18153, B-18169, B-19182, B-19218, B-19221, B-19493, B-19705, B-19850, B-20120, B-20258, B-20369, B-20625, B-20628, B-20709, B-20796, B-20824, B-20877, B-20878, B-21006, B-21051, B-21220, B-21294, B-21647, B-21677, B-21702, B-21888, B-21938, B-22061, B-22353, B-22357, B-22400, B-22518, B-22522, B-22525, B-22538, B-22838, B-22988, B-23002, B-23008, B-23067, B-23117, B-23319, B-23371, B-23456, B-23493, B-23538, B-23594, B-23836, B-23885, B-23901, B-24079, B-24380, B-24743, B-24810, B-24969, B-24988, B-25017, B-25224, B-25379, B-25479, B-25554, B-25594, B-25623, B-25694, B-25711, B-25858, B-25950, B-25977, B-26002, B-26014, B-26056, B-26057, B-26125, B-26128, B-26172, B-26173, B-26176, B-26296, B-26308, B-26567, B-26568, B-26618, B-26730, B-26731, B-26836, B-26908, B-27154, B-27288, B-27357, B-27541, B-27548, B-27605, B-27674, B-27719, B-27732, B-27793, B-27818, B-28047, B-28118, B-28206, B-28756, B-29131, B-29251, B-29278, B-29323, B-29363, B-29437, B-29448, B-29533, B-29601, B-29745, B-29761, B-29877, B-29978, B-30062, B-30124, B-30350, B-30479, B-30530, B-30738, B-30782, B-30809, B-30943, B-31062, B-31072, B-31178, B-31211, B-31233, B-31302, B-31456, B-31463, B-31631, B-31700, B-31790, B-31794, B-31911, B-31945, B-32070, B-32099, B-32119, B-32166, B-32302, B-32497, B-32498, B-32615, B-32634, B-32646, B-32681, B-32768, B-32781, B-32797, B-32798, B-32799, B-32847, B-32900, B-32913, B-32935, B-32937, B-33003, B-33073, B-33077, B-33120, B-33122, B-33380, B-33398, B-33617, B-33742, B-33793, B-33816, B-33854, B-34073, B-34385, B-34679, B-34778, B-34868, B-35554, B-35595, B-35609, B-35660, B-35803, B-35879, B-35955, C-04883, C-05170, C-05614, C-05898, C-13749, C-17639, C-24429, C-25054, C-26966, C-29891, C-31924, C-32676, C-34047, D-00209, D-00373, D-07572, D-09592, D-16062, D-23149, D-33539, F-10308, F-12662, F-16828, F-26529, G-00208, G-00715, G-03788, G-07821, G-34667, I-24187, J-16457, J-29299, K-00157, K-31516, L-03540, L-06732, L-14028, L-14932, L-16330, L-30149, L-32796, L-33725, L-35752, M-30896

ODORIMETRY A-03825, A-04785, A-04860, A-17631, A-17632, A-19899, A-20553, A-20557, A-20706, A-21857, A-24350, A-25228, A-25455, A-26826, A-29698, A-30851, A-31044, A-31263, A-32475, A-32855, A-33713, A-34891, A-34964, B-00032, B-03946, B-03966, B-04533, B-05490, B-06106, B-06453, B-08506, B-08604, B-09608, B-10005, B-11136, B-12480, B-13971, B-14013, B-20120, B-20877, B-20878, B-23371, B-23885, B-24380, B-25594, B-27288, B-29448, B-29877, B-30809, B-31302, B-32099, B-32646, B-32797, B-32798, B-35879, C-00178, C-04117, C-05170, C-05396, C-05426, C-05813, C-05898, C-07266, C-08066, C-08678, C-08953, C-09364, C-09521, C-09620, C-09648, C-09657, C-09660, C-09716, C-09860, C-10016, C-10029, C-10593, C-10693, C-10983, C-11167, C-11486, C-12359, C-12479, C-12487, C-12492, C-12665, C-12942, C-13367, C-13627, C-13749, C-13969, C-14108, C-14109, C-14606, C-15677, C-16080, C-16540, C-16754, C-16781, C-17044, C-17288, C-17290, C-17638, C-17639, C-17640, C-17641, C-18093, C-18194, C-19051, C-20264, C-20624, C-21652, C-21693, C-21858, C-21866, C-22431, C-22448, C-22958, C-23004, C-23106, C-23755, C-24071, C-24429, C-24814, C-25054, C-25065, C-25466, C-26096, C-26309, C-26837, C-26966, C-27121, C-27355, C-27475, C-27685, C-27733, C-27791, C-27934, C-28141, C-28393, C-28787, C-29243, C-29269, C-29508, C-29726, C-29843, C-29858, C-29891, C-29929, C-30374, C-30689, C-30811, C-31222, C-31924, C-32022, C-32268, C-32269, C-32467, C-32676, C-32795, C-32880, C-33121, C-33349, C-33577, C-34047, C-34178, C-34279, C-34972, C-35182, C-35240, C-35541, C-35648, C-35751, C-35865, C-35949, C-35956, D-07572, D-17630, D-18231, D-23098, D-23149, D-23152, D-29349, D-31371, F-11132, F-13107, F-13670, F-19061, F-19063, F-19102, F-22429, F-29649, F-32271, F-33084, F-35651, G-00715, G-05942, G-05943, G-05946, G-05949, G-09659, G-19599, G-20969, G-21359, G-34667, G-34686, G-35671, K-05947, K-20194, K-21083, K-21084, K-31968, L-03540, L-04841, L-04888, L-10484, L-28348, L-30149, L-32566, L-35511, L-35752, M-23408, M-26725, M-30896

ODORS A-00393, A-00402, A-00525, A-01565, A-01644, A-01885, A-02001, A-02765, A-03097, A-03825, A-04785, A-04860, A-04879, A-04893, A-05007, A-05335, A-05527, A-05549, A-05608, A-06039, A-06240, A-07089, A-07394, A-07561, A-08359, A-08373, A-08802, A-08912, A-09175, A-09255, A-09853, A-10075, A-10699, A-11144, A-11692, A-11700, A-11969, A-12083, A-12377, A-12505, A-12507, A-12832, A-12834, A-14116, A-14297, A-14914, A-14972, A-15297, A-16058, A-16135, A-16494, A-17198, A-17236, A-17462, A-17603, A-17631, A-17632, A-17633, A-17634, A-19814, A-20101, A-20118, A-20125, A-20134, A-20276, A-20553, A-20557, A-20706, A-21661, A-21700, A-21857, A-21882, A-22860, A-22973, A-22987, A-23000, A-23313, A-23314, A-23843, A-24350, A-24459, A-24500, A-24527, A-24754, A-24903, A-25228, A-25327, A-25455, A-25638, A-26048, A-26574, A-26575, A-26605, A-26826, A-26911, A-27129, A-27235, A-27249, A-27451, A-27669, A-27821, A-27972, A-27986, A-28295, A-28527, A-28614, A-28885, A-29332, A-29353, A-29599, A-29698, A-29842, A-30218, A-30327, A-30389, A-30513, A-30603, A-30687, A-30851, A-31044, A-31155, A-31157, A-31263, A-31323, A-31602, A-31759, A-31880, A-31882, A-32411, A-32465, A-32475, A-32489, A-32653, A-32855, A-32878, A-32879, A-33188, A-33564, A-33648, A-33713, A-33719, A-33828, A-33983, A-34018, A-34287, A-34290, A-34585, A-34766, A-34891, A-34964, A-35564, A-35581, A-35599, A-35622, A-35635, A-35638, A-35693, B-00025, B-00032, B-00246, B-00257, B-00286, B-00358, B-00379, B-00504, B-00541, B-00552, B-00571, B-00975, B-01352, B-01414, B-01505, B-01508, B-01537, B-01549, B-01563, B-01613, B-01672, B-01867, B-01900, B-02018, B-02047, B-02279, B-02427, B-02488, B-02725, B-02729, B-02794, B-03129, B-03297, B-03807, B-03946, B-03966, B-03972, B-04045, B-04300, B-04361, B-04533, B-04627, B-04664, B-04666, B-04669, B-04773, B-04838, B-04861, B-04882, B-04887, B-04943, B-04949, B-04950, B-04951, B-04952, B-04953, B-05332, B-05408, B-05409, B-05490, B-05624, B-05808, B-05852, B-05862, B-05880, B-05929, B-05930, B-06103, B-06106, B-06280, B-06363, B-06366, B-06412, B-06453, B-06525, B-06636, B-06688, B-06859, B-06979, B-07224, B-07362, B-07374, B-07415, B-07429, B-07434, B-07479, B-07530, B-07531, B-07875, B-07971, B-08104, B-08360, B-08361, B-08364, B-08467, B-08497, B-08506, B-08604, B-08663, B-08946, B-09407, B-09508, B-09608, B-09655, B-09656, B-09661, B-09729, B-09784, B-09791, B-09794, B-09813, B-09815, B-09819, B-09827, B-09830, B-09836, B-09839, B-09840, B-09842, B-09849, B-09852, B-09854, B-09857, B-09922, B-09933, B-10005, B-10009, B-10277, B-10588, B-10994, B-11008, B-11009, B-11059, B-11136, B-11137, B-11153, B-11158, B-11220, B-11234, B-11673, B-11843, B-12133, B-12346, B-12434, B-12480, B-12482, B-12506, B-12658, B-13398, B-13551, B-13697, B-13772, B-14013, B-14094, B-14113, B-14118, B-14203, B-14341, B-14354, B-14609, B-14671, B-14687, B-14692, B-14757, B-14951, B-14956, B-14967, B-15153, B-15170, B-15690, B-15772, B-15779, B-16113, B-16365, B-16498, B-16535, B-16712, B-16747, B-16807, B-16842, B-16890, B-17177, B-17238, B-17266, B-17293, B-17314, B-17395, B-17403, B-17409, B-17635, B-17636, B-17637, B-17906, B-18050, B-18153, B-18169, B-19182, B-19218, B-19221, B-19363, B-19493, B-19705, B-20120, B-20258, B-20625, B-20628, B-20709, B-20754, B-20796, B-20817, B-20824, B-20877, B-20878, B-21006, B-21220, B-21294, B-21677, B-21938, B-22061, B-22353, B-22357, B-22400, B-22435, B-22518, B-22522, B-22525, B-22538, B-22550, B-22837, B-22988, B-23002, B-23008, B-23067, B-23117, B-23456, B-23493, B-23594, B-23836, B-23885, B-23901, B-23967, B-24065, B-24079, B-24090, B-24197, B-24380, B-24845, B-24969, B-24988, B-25017, B-25085, B-25224, B-25554, B-25858, B-25950, B-25977, B-26014, B-26056, B-26087, B-26128, B-26173, B-26254, B-26567, B-26568, B-26730, B-26731, B-26778, B-26836, B-26843, B-26908, B-26944, B-27154, B-27288, B-27336, B-27357, B-27401, B-27541, B-27605, B-27674, B-27719, B-27732, B-27793, B-28108, B-28118, B-28146, B-28206, B-28756, B-29131, B-29261, B-29448, B-29601, B-29628, B-29745, B-29761, B-29877, B-29978, B-30260, B-30339, B-30350, B-30530, B-30738, B-30865, B-30943, B-31062, B-31091, B-31160, B-31167, B-31178, B-31211, B-31223, B-31233, B-31301, B-31302, B-31354, B-31400, B-31453, B-31456, B-31463, B-31472, B-31631, B-31700, B-31790, B-31911, B-32057, B-32099, B-32166, B-32302, B-32559, B-32615, B-32634, B-32646, B-32681, B-32682, B-32768, B-32781, B-32798, B-32847, B-32935, B-32956, B-33003, B-33073, B-33077, B-33122, B-35566, C-00178, C-00965, C-01289, C-02786, C-03010, C-03354, C-03542, C-03789, C-04117, C-04883, C-05170, C-05396, C-05426, C-05503, C-05614, C-05898, C-06112, C-06381, C-06526, C-07214, C-07266, C-08066, C-08268, C-08354, C-08355, C-08356, C-08357, C-08358, C-08678, C-08953, C-09364, C-09476, C-09521, C-09619, C-09620, C-09648, C-09657, C-09660, C-09716, C-09860, C-10016, C-10029, C-10534, C-10593, C-10693, C-10983, C-11123, C-11167, C-11486, C-12359, C-12479, C-12487, C-12488, C-12492, C-12665, C-12942, C-13099, C-13143, C-13749, C-13969, C-14108, C-14197, C-14606, C-14607, C-14680, C-15287, C-15677, C-16080, C-16134, C-16298, C-16442, C-16540, C-16754, C-16781, C-17044, C-17288, C-17290, C-17627, C-17628, C-17629, C-17638, C-17639, C-17640, C-17641, C-18093, C-18194, C-19051, C-20100, C-20192, C-20202, C-20264, C-20460, C-20538, C-20624, C-21208, C-21652, C-21858, C-21859, C-21866, C-22431, C-22448, C-22958, C-23004, C-23106, C-23107, C-24071, C-24814, C-25065, C-25466, C-26096, C-26309, C-26547, C-26837, C-26966, C-27121, C-27248, C-27355, C-27475, C-27685, C-27733, C-27791, C-27934, C-28393, C-28787, C-29243, C-29269, C-29337, C-29726, C-29891, C-29929, C-30014, C-30374, C-30704, C-30811, C-31222, C-31924, C-32268, C-32269, C-32467, C-32676, C-32880, C-33121, C-33349, C-33577, C-34047, C-34279, C-34863, C-34972, C-35182, C-35240, C-35541, C-35648, C-35751, C-35865, C-35949, C-35956, D-00209, D-00241, D-00251, D-00373, D-00690, D-00751, D-01202, D-01949, D-02212, D-02331, D-02339, D-03001, D-03017, D-03418, D-03431, D-03459, D-03506, D-03514, D-05256, D-05481, D-06535, D-07572, D-09590, D-09592, D-12426, D-12648, D-16635, D-16636, D-17630, D-18231, D-20355, D-23098, D-23149, D-23152, D-23411, D-23845, D-24162, D-25291, D-25780, D-25996, D-26304, D-27255, D-29349, D-29973, D-31371, D-31760, D-33108, D-33539, D-33723, D-35764, E-19849, E-22335, E-26550, F-01784, F-03173, F-10308, F-11132, F-12449, F-12662, F-16455, F-16828, F-17801, F-19061, F-19063, F-22429, F-22430, F-23187, F-24354, F-24531, F-25761, F-26529, F-29649, F-32271, F-33084, F-35651, G-00177, G-00208, G-00715, G-03788, G-05943, G-06323, G-07091, G-09659, G-11476, G-21125, G-21712, G-28175, G-34667, G-34686, G-35570, H-00252, I-05463, I-19325, J-16457, J-29299, J-34518, K-00157, K-05117, K-07766, K-11734, K-15926, K-16263, K-18294, K-20194, K-21083, K-21084, K-21918, K-27403, K-30870, K-31286, K-31516, K-35146, L-00054, L-00871, L-00973, L-01528, L-01604, L-02294, L-02295, L-02840, L-03198, L-03540, L-04841, L-04888, L-04942, L-05129, L-07235, L-07781, L-09215, L-09604, L-09677, L-10484, L-10567, L-12376, L-12511, L-14616, L-14798, L-15554, L-15688, L-15691, L-16330, L-17258, L-19059, L-22343, L-23754, L-25446, L-26511, L-26940, L-27184, L-27185, L-27677, L-27678, L-27679, L-28348, L-28363, L-29679, L-29813, L-29975, L-30149, L-30153, L-30686, L-31084, L-31465, L-32147, L-32171, L-32352, L-32354, L-32382, L-32383, L-32566, L-32626, L-32796, L-32893, L-33117, L-33672, L-33725, L-34033, L-34256, L-34755, L-34926, L-35511, L-35694, L-35752, M-00376, M-00487, M-00844, M-01069, M-08698, M-13980, M-14491, M-15760, M-23408, M-24091, M-24768, M-26725, M-27680, M-30896, M-31071, N-01539, N-03438, N-05235, N-19060, N-19088, N-20495, N-32254

OHIO A-05608, B-06636, B-26087, C-00178, D-03459, D-09590, D-23845, D-25780, L-00973, L-09677

OIL BURNERS A-02001, A-10075, A-33719, A-35383, B-04361, B-23002, B-23885, B-26567, B-27541, B-31631, K-31286, L-30149

OLEFINS A-05007, A-05549, A-26911, A-27451, A-29599, A-32475, A-33564, B-03129, B-06636, B-14341, B-15772, B-16498, B-22838, B-28118, B-32956, C-07214, C-08066, C-08354, C-10693, D-00251, D-23149, D-23152, D-29349, D-31760, G-00177, K-11734, K-21083

OPEN BURNING A-03097, A-16058, A-23313, A-23314, A-26911, A-35564, A-35693, B-09784, B-32682, C-35956, D-00751, D-01949, D-02331, D-03431, D-09590, D-23411, K-07766, K-31516, L-02840, L-09604, L-19059, L-32147, L-32171, L-32382, L-32383, L-32626

OPEN HEARTH FURNACES B-26254, B-32937, D-29973, L-01528, L-09677

OPERATING CRITERIA A-14116, A-21395, A-25638, B-14341, B-14687, C-33121, G-06323, L-09677

OPERATING VARIABLES A-10075, A-17462, A-19366, A-20125, A-22860, A-26574, A-26911, A-32385, A-33648, A-34585, A-34654, A-34891, A-35581, A-35590, B-09655, B-09830, B-17403, B-23493, B-25694, B-26125 B-26730, B-29278, B-30738, B-30865, B-30943, B-31091, B-31211, B-31453, B-31463, B-31631, B-31794, B-31945, B-32070, B-32119, B-32497, B-32498, B-32559, B-32634, B-32847, B-32937, B-33077, B-33793, B-33816, B-34073, B-34385, B-35566, C-12487, C-12488, C-17290, C-35956, I-19325, L-31465

OPINION SURVEYS A-24350, A-28295, B-00032, B-29761, B-33077, D-01202, D-06535, D-09592, G-00208, J-34518, L-00054, L-01604, L-29975, M-00376, M-00487, M-00844, M-01069, M-08698, M-14491, M-23408, M-27680, M-30896, N-01539

OREGON B-04783, D-01949, L-09677, L-30149

ORGANIC ACIDS A-00393, A-05007, A-07394, A-07561, A-17198, A-17631, A-29599, A-29842, A-31880, A-32411, A-32475, A-32855, A-34018, A-34964, B-00975, B-01414, B-03966, B-07362, B-07531, B-09827, B-09849, B-09852, B-14967, B-19493, B-24969, B-31091, B-32099, B-32166, B-33077, C-03010, C-08066, C-09521, C-11123, C-11167, C-14109, C-14607, C-17044, C-18093, C-28141, C-28393, C-29269, C-32268, C-32269, C-33577, C-35865, C-35956, D-06535, D-07572, D-09592, D-23152, D-31371, D-35764, F-29649, I-19325, L-00054, L-27678, L-27679

ORGANIC NITROGEN COMPOUNDS A-07089, A-09853, A-17198, A-17631, A-19899, A-23843, A-29599, A-29842, A-31044, B-01508, B-02729, B-04300, B-04627, B-05624, B-05862, B-07530, B-07531, B-09836, B-09849, B-09854, B-12480, B-15772, B-20625, B-26014, B-26836, B-27605, B-27674, B-29131, B-29363, B-29448, B-29745, B-29978, B-31302, B-31700, B-32099, B-32166, B-32768, C-08066, C-09521, C-10693, C-11123, C-13099, C-13749, C-14109, C-17627, C-17628, C-17638, C-17640, C-20202, C-20624, C-21858, C-23004, C-26547, C-26837, C-27685, C-27791, C-27934, C-28141, C-29726, C-30704, C-30811, C-32269, C-32467, C-33577, C-35865, F-29649, L-32796

ORGANIC PHOSPHORUS COMPOUNDS B-00975, C-09521, C-35182

ORGANIC SULFUR COMPOUNDS A-01644, A-01885, A-04785, A-04893, A-06240, A-08359, A-11144, A-12507, A-14580, A-16494, A-17198, A-17631, A-17633, A-19899, A-20134, A-21857, A-24903, A-28527, A-29599, A-29842, A-31044, A-31263, A-32475, A-32879, A-33983, B-00025, B-00286, B-00379, B-00975, B-01414, B-01505, B-01508, B-01563, B-01672, B-01900, B-02018, B-02427, B-02488, B-03807, B-04045, B-04627, B-04773, B-04838, B-04861, B-04882, B-04887, B-04950, B-04951, B-04952, B-04953, B-05408, B-05409, B-05808, B-06106, B-06363, B-07434, B-07531, B-08360, B-08361, B-08364, B-08467, B-09508, B-09655, B-09661, B-09854, B-09922, B-10277, B-10994, B-11008, B-11673, B-12506, B-13072, B-14113, B-14488, B-14692, B-15779, B-16365, B-16747, B-16842, B-17266, B-17293, B-19218, B-19850, B-20369, B-20625, B-21294, B-22061, B-22400, B-22838, B-23538, B-24380, B-25224, B-26014, B-26176, B-26254, B-26908, B-27674, B-29278, B-29745, B-31302, B-31790, B-32099, B-32166, B-32615, B-32681, B-32798, B-32956, B-35595, B-35803, C-00965, C-01289, C-04883, C-05426, C-06381, C-06526, C-07214, C-08066, C-08354, C-08355, C-08356, C-08357, C-08358, C-09521, C-09619, C-09648, C-09657, C-10983, C-11123, C-13749, C-14108, C-17629, C-17639, C-17640, C-19051, C-20202, C-21858, C-21859, C-23004, C-24071, C-24814, C-26547, C-27355, C-27685, C-27934, C-29243, C-29726, C-30704, C-30811, C-31924, C-32467, C-32880, C-33349, C-34279, C-34863, C-35865, C-35956, D-00209, D-09592, D-16062, D-29349, D-31371, D-33723, F-01784, F-10308, F-12662, F-16828, F-29649, G-00208, G-03788, G-09659, L-00054, L-32354, L-32796, L-32893, L-33725, M-08698, M-27680, N-19060

ORGANIC WASTES A-26575, A-31155, A-31157, A-35564, A-35673, B-06412, B-19182, B-22435, B-22518, B-22550, B-25977, B-29448, B-30530, B-31302, B-32497, B-32682, B-33816, B-35595, B-35879, C-13099, C-13749, C-27791, C-35865, D-02339, F-29649

ORLON B-09813, B-27605

ORSAT ANALYSIS A-05549, B-03966, B-07224, C-03010, C-04117, C-35956, D-00251

OVERFIRE AIR A-28861, B-10009, B-35566

OXIDANT PRECURSORS B-00975

OXIDANTS A-05007, A-06240, A-21661, A-24459, A-30513, A-34018, A-35622, B-00975, B-16890, B-21294, B-30865, C-09476, C-27248, C-29843, C-34279, D-09590, D-25996, D-31760, G-23298, K-07766, K-11734, K-31968, L-01604, L-02840, L-03198, L-34256, L-34926, M-24091

OXIDATION A-25179, A-32411, A-33983, A-34654, A-34766, B-00257, B-00358, B-00379, B-01505, B-01508, B-01900, B-02279, B-03499, B-03807, B-03972, B-04045, B-04838, B-04882, B-05624, B-05808, B-05929, B-06106, B-06363, B-06859, B-06979, B-07362, B-07479, B-08360, B-08361, B-08364, B-09661, B-09830, B-09836, B-09839, B-09933, B-10005, B-10994, B-11008, B-11009, B-14203, B-15772, B-15948, B-17293, B-20824, B-22525, B-24079, B-25379, B-26128, B-26176, B-26843, B-29131, B-29978, B-30738, B-31794, B-32559, B-32615, B-32768, B-32935, B-33077, B-33122, C-08354, C-14607, C-25065, C-31924, C-35182, E-22335, F-10308, F-23187, F-29649, G-00177, G-07821, L-04888, L-32796

OXIDES A-00402, A-00525, A-01565, A-02001, A-05007, A-05527, A-05549, A-06039, A-06240, A-07561, A-08373, A-08802, A-09175, A-09255, A-10075, A-12377, A-12621, A-12998, A-14116, A-14297, A-16135, A-17633, A-20101, A-20125, A-20134, A-20276, A-21661, A-22973, A-23843, A-24459, A-24500, A-25205, A-25455, A-26048, A-26402, A-26911, A-27129, A-27249, A-27451, A-28352, A-28614, A-30218, A-30513, A-30603, A-31323, A-31759, A-31880, A-31882, A-32411, A-32465, A-32475, A-32489, A-32653, A-32855, A-32879, A-33648, A-33719, A-33828, A-33883, A-34018, A-34891, A-35564, A-35635, B-00025, B-00504, B-00975, B-01505, B-01508, B-01672, B-01867, B-02018, B-02427, B-03966, B-04300, B-04361, B-04627, B-04783, B-04838, B-05332, B-05808, B-05880, B-06280, B-06636, B-07224, B-07362, B-07530, B-07875, B-07971, B-08104, B-08364, B-08467, B-08497, B-08604, B-08663, B-09508, B-09655, B-09784, B-09827, B-09830, B-09854, B-09933, B-11008, B-11009, B-11234, B-13551, B-14118, B-14671, B-14692, B-14967, B-16365, B-16747, B-17906, B-19493, B-19705, B-20369, B-20817, B-20878, B-21220, B-22061, B-22522, B-22837, B-22838, B-23008, B-24079, B-24743, B-24845, B-24969, B-24988, B-25479, B-25554, B-26087, B-26254, B-26908, B-26944, B-27401, B-27541, B-27719, B-28108, B-28146, B-28756, B-29437, B-29533, B-30124, B-30738, B-30865, B-31062, B-31091, B-31167, B-31233, B-31354, B-31400, B-32070, B-32119, B-32302, B-32559, B-32646, B-32681, B-32956, B-33077, B-33816, B-33854, C-00965, C-02786, C-03010, C-03354, C-03542, C-04117, C-04883, C-05170, C-05426, C-05503, C-06112, C-07214, C-07266, C-08066, C-08354, C-08355, C-08356, C-08358, C-09476, C-09619, C-09657, C-11123, C-14109, C-16298, C-16781, C-19051, C-20100, C-23107, C-27248, C-27733, C-27934, C-29337, C-29843, C-30014, C-30704, C-32467, C-34279, C-34863, C-35949, C-35956, D-00241, D-00251, D-00373, D-01949, D-03001, D-03017, D-03506, D-03514, D-05481, D-06535, D-07572, D-09590, D-09592, D-16636, D-23411, D-23845, D-24162, D-25291, D-25780, D-25996, D-26304, D-27255, D-29973, D-31371, D-31760, D-33108, D-33539, D-33723, D-35764, E-19849, E-22335, E-26550, F-01784, F-07681, F-16828, F-23187, F-25761, G-00177, G-00715, G-20969, G-21125, G-34686, H-20028, I-05463, I-19325, J-34518, K-00157, K-05947, K-07766, K-11734, K-16263, K-18294, K-21918, K-27403, K-31516, K-31968, K-35146, L-00054, L-00973, L-01528, L-01604, L-02840, L-03198, L-04888, L-04942, L-07235, L-09677, L-12511, L-14616, L-14798, L-17258, L-19059, L-25446, L-26511, L-27184, L-27185, L-27677, L-27678, L-27679, L-28348, L-29679, L-29813, L-29975, L-31084, L-32147, L-32171, L-32352, L-32382, L-33672, L-34926, L-35511, M-01069, M-08698, M-24091, M-31071, N-03438, N-19060, N-20495, N-32254

OXYGEN A-03825, A-05549, A-09175, A-24007, A-32411, A-32489, B-01508, B-01672, B-05408, B-05624, B-05808, B-08364, B-08663, B-13398, B-16535, B-25085, B-25224, B-27818, B-29278, B-31072, B-31794, B-32119, B-34778, C-03010, C-08354, C-19051, C-30704, C-32467, C-34279, D-00373, F-07681

OXYGEN CONSUMPTION D-31371

OXYGENATED FRACTIONS A-32653, B-31400, L-34926

OZONE A-05007, A-21661, A-25179, A-25228, B-00975, B-01508, B-04664, B-04666, B-04861, B-05624, B-06688, B-08364, B-10005, B-11059, B-15772, B-15948, B-16535, B-17238, B-20628, B-21294, B-22061, B-29131, B-29601, B-29978, B-30809, B-32768, B-32798, C-06112, C-09476, C-27248, C-27791, C-34279, D-09590, D-31760, E-19849, E-22335, F-10308, G-00177, G-07821, G-23298, G-34686, G-35671, L-01604, L-03198, L-32796, N-19060

P

PACKED TOWERS B-00358, B-01352, B-04949, B-07429, B-07434, B-08364, B-11008, B-12482, B-13772, B-20817, B-26173, B-30350

PAINT MANUFACTURING A-23843, A-24754, B-02427, B-05532, B-06088, B-07362, B-09791, B-17293, B-18050, B-21294, B-22988, B-23967, B-29761, B-35595, C-20538, C-26966, C-31924

PAINT REMOVERS B-07362, B-27732, C-08066

PAINTS A-23843, B-08506, B-21294, B-26087, B-27732, C-08066, D-02339, D-06535, D-09592, I-05463, L-00054

PAPER CHROMATOGRAPHY A-30701, A-32411, A-35581, B-09830, C-35865

PAPER MANUFACTURING A-01644, A-01885, A-12621, A-14580, A-17198, A-17603, A-19899, A-20134, A-20553, A-24903, A-25205, A-30701, A-35581, B-00025, B-00379, B-00552, B-01505, B-01549, B-01563, B-01672, B-02018, B-02279, B-03129, B-08467, B-11158, B-12658, B-13334, B-15709, B-17266, B-22400, B-23117, B-25085, B-30339, B-31091, B-31463, B-31794, B-32615, B-32768, B-34868, C-19051, C-23106, C-35956, D-00690, D-03017, D-07572, D-09592, D-12648, D-17630, F-01784, F-10308, K-31516, L-00871, L-06732, L-14932, L-31465, M-00376, M-08698, M-15760

PARTICLE COUNTERS B-04361, B-05532

PARTICLE GROWTH A-00393, B-07530, B-28146

PARTICLE SHAPE B-05532, C-09476, C-32268, F-19061

PARTICLE SIZE A-00393, A-08912, A-09853, A-28614, A-32489, A-32653, A-33828, B-03976, B-04361, B-04949, B-05332, B-05532, B-05624, B-06088, B-23319, B-26296, B-27674, B-28047, B-29533, B-31233, B-31301, B-31456, B-32634, B-32937, B-35554, C-03010, C-09476, C-27248, C-35956, D-29973, G-00177, G-07091, I-05463, K-31968
PARTICULATE CLASSIFIERS A-00393, A-08912, A-09853, A-28614, A-32489, A-32653, A-33828, B-03976, B-04361, B-04949, B-05332, B-05532, B-05624, B-06088, B-23319, B-26296, B-27674, B-28047, B-29533, B-31233, B-31301, B-31456, B-32634, B-32937, B-35554, C-03010, C-09476, C-27248, C-32268, C-35956, D-29973, F-14987, F-19061, G-00177, G-07091, I-05463, K-31968, N-03438
PARTICULATE SAMPLING A-00393, A-09175, B-01414, B-03966, C-02786, C-03789, C-04117, C-06112, C-35956, D-02212, D-05481, D-09590
PARTICULATES A-00393, A-00402, A-01565, A-02001, A-03097, A-05007, A-05335, A-05527, A-05549, A-06039, A-07394, A-07561, A-08373, A-08802, A-08912, A-09175, A-09853, A-10075, A-10699, A-11651, A-12083, A-12377, A-12505, A-12621, A-14116, A-14297, A-14914, A-14972, A-16058, A-17462, A-17633, A-17634, A-20101, A-20125, A-20134, A-20276, A-21882, A-22860, A-23313, A-23314, A-24007, A-24459, A-24500, A-24903, A-25056, A-25205, A-25327, A-25638, A-26048, A-26402, A-26574, A-26575, A-26605, A-26911, A-27129, A-27235, A-27249, A-27451, A-27669, A-27821, A-27986, A-28614, A-28861, A-29332, A-29353, A-30389, A-30603, A-30687, A-31323, A-31759, A-31880, A-31882, A-32385, A-32465, A-32489, A-32653, A-33188, A-33648, A-33719, A-33828, A-34018, A-34228, A-34290, A-34654, A-34891, A-35383, A-35564, A-35693, B-00025, B-00246, B-00257, B-00379, B-00504, B-00541, B-00975, B-01352, B-01414, B-01505, B-01508, B-01537, B-01549, B-01613, B-01867, B-02018, B-02047, B-02279, B-02427, B-02725, B-03129, B-03966, B-03976, B-04227, B-04361, B-04533, B-04664, B-04838, B-04882, B-04943, B-04949, B-05332, B-05490, B-05532, B-05852, B-05880, B-05929, B-05930, B-06088, B-06280, B-06366, B-06453, B-06525, B-06636, B-06859, B-06979, B-07224, B-07415, B-07429, B-07479, B-07530, B-07531, B-07875, B-07971, B-08104, B-08360, B-08497, B-08506, B-08663, B-08946, B-09407, B-09508, B-09608, B-09655, B-09733, B-09784, B-09791, B-09794, B-09813, B-09815, B-09819, B-09827, B-09830, B-09836, B-09839, B-09840, B-09842, B-09849, B-09852, B-09854, B-09857, B-10009, B-10277, B-10994, B-11008, B-11137, B-11158, B-11220, B-11234, B-13551, B-13697, B-14094, B-14118, B-14341, B-14354, B-14609, B-14687, B-14895, B-14951, B-14956, B-14967, B-15170, B-15709, B-16842, B-17403, B-17906, B-18140, B-19218, B-19221, B-19363, B-19705, B-19850, B-20120, B-20817, B-20877, B-20878, B-21006, B-21220, B-21647, B-21938, B-22353, B-22357, B-22435, B-22518, B-23008, B-23067, B-23319, B-23493, B-23836, B-23885, B-24065, B-24090, B-24380, B-24810, B-24845, B-24969, B-24988, B-25017, B-25554, B-25694, B-26087, B-26254, B-26296, B-26308, B-26567, B-26568, B-26730, B-26731, B-26778, B-26908, B-26944, B-27288, B-27541, B-27548, B-27732, B-27793, B-27818, B-28146, B-29323, B-29363, B-29437, B-29533, B-29761, B-30124, B-30479, B-30530, B-30773, B-30865, B-30943, B-31062, B-31160, B-31167, B-31223, B-31233, B-31301, B-31354, B-31400, B-31453, B-31456, B-31472, B-31631, B-31700, B-31945, B-32057, B-32615, B-32634, B-32682, B-32781, B-32847, B-32913, B-32937, B-32956, B-33077, B-33120, B-33793, B-33854, B-34679, B-35554, B-35566, B-35660, B-35803, B-35955, C-03010, C-03542, C-03789, C-04117, C-05503, C-06112, C-07214, C-09476, C-10534, C-11167, C-14197, C-15287, C-20100, C-21208, C-23107, C-29337, C-29858, C-32022, C-35956, D-00241, D-00251, D-00373, D-00690, D-00751, D-01202, D-01949, D-02212, D-03001, D-03017, D-03418, D-03431, D-03459, D-03506, D-03514, D-05481, D-07572, D-09590, D-09592, D-12426, D-12648, D-16636, D-18231, D-23411, D-23845, D-24162, D-25291, D-25780, D-25996, D-29973, D-31371, D-31760, D-33108, D-33539, D-35764, E-19849, E-26550, G-00177, G-05942, I-05463, I-24187, J-16457, J-29299, J-34518, K-00157, K-07766, K-11734, K-15926, K-16263, K-18294, K-31286, K-31516, K-31968, K-35146, L-00054, L-00973, L-01528, L-01604, L-02295, L-02840, L-03198, L-04841, L-04888, L-04942, L-06732, L-07235, L-07781, L-09215, L-09604, L-09677, L-10567, L-12376, L-12511, L-14616, L-15554, L-15688, L-15691, L-17258, L-19059, L-25446, L-26511, L-27184, L-27185, L-27677, L-27678, L-27679, L-28363, L-29679, L-29813, L-29975, L-30149, L-30153, L-31084, L-32147, L-32171, L-32352, L-32354, L-32382, L-32383, L-32626, L-33672, L-34256, L-34926, L-35511, L-35694, M-00376, M-01069, M-08698, M-15760, M-24091, M-26725, M-31071, N-03438, N-19060, N-19088, N-32254
PATHOLOGICAL TECHNIQUES G-05949

PENELEC (CONTACT PROCESS) B-09839, B-26908
PENNSYLVANIA A-35693, B-06636, B-31062, L-00973, L-09677, L-10567, L-32626
PENTANES G-00177
PENTENES D-00251, G-00177
PERMEABILITY B-29323, B-32799
PERMITS B-09784, C-03010, L-00549, L-07781, L-09215, L-10567, L-32171, L-32352, L-32382, L-35694
PEROXIDES B-32646
PEROXYACETYL NITRATE D-09590
PEROXYACYL NITRATES B-06636, C-34279, D-09590, E-19849
PERSONNEL A-27669, B-00975, B-30260, C-08066, C-08678, C-25054, D-00751, L-05129, L-07235, L-14616, L-30688, L-33672, M-31071, N-01539
PERSONNEL QUALIFICATIONS C-16540, D-18231, L-05129
PERYLENES C-03542, D-00251
PEST CONTROL L-15688
PESTICIDES A-26911, A-35564, B-02488, B-06688, B-09784, B-32682, C-27248, C-35182, D-23411
PETER SPENCE PROCESS (CLAUS) B-22353
PETROLEUM DISTRIBUTION A-33883, B-09784, B-09839, B-09840, D-00690, L-32171, L-32382, L-32383, L-34033
PETROLEUM PRODUCTION A-04785, A-12083, A-19899, A-24350, A-29599, A-30513, B-05532, B-09836, B-09839, B-09840, B-09922, B-25479, B-28108, B-28118, B-29745, C-16134, C-27355, D-20355, D-29349, L-34033, N-01539
PETROLEUM REFINING A-04785, A-17603, A-20553, A-24527, A-29599, A-30513, A-31880, A-31882, A-32465, A-32475, A-33883, B-00975, B-01537, B-08467, B-09784, B-09794, B-09836, B-09839, B-09840, B-09842, B-09857, B-09922, B-12480, B-13551, B-14940, B-17293, B-19850, B-22353, B-22435, B-22518, B-25479, B-26618, B-26908, B-27719, B-28118, B-29628, B-29745, B-31223, B-32900, B-32956, B-35595, C-20460, C-21859, C-22958, C-26966, C-27355, C-29726, C-31924, C-32467, C-34047, D-31371, D-33723, F-01784, G-00715, L-07235, L-14798, L-27184, L-27185, L-32796, L-32893, L-34033, M-14491, M-15760, M-30896
PETUNIAS D-09590
PH A-01644, A-01885, A-17634, B-00379, B-01563, B-04627, B-04882, B-04887, B-04951, B-04952, B-04953, B-08361, B-09655, B-19705, B-23538, B-29278, B-32166, B-32615, C-09619, C-17641, F-12662, I-05463
PHENANTHRENES B-02725
PHENOLS A-07561, A-12083, A-23843, A-32855, A-33564, A-33983, B-01414, B-04627, B-06366, B-08506, B-14692, B-24090, B-26843, B-32956, C-10983, C-11123, C-14607, C-27934, D-31760
PHENYL COMPOUNDS A-07089, B-04627, B-09839, C-11123, C-11486, C-14109, C-15287, C-18093, D-23149, G-05949
PHENYLS A-07089, B-04627, C-11123, C-11486, C-14109, C-15287, C-18093, D-23149
PHILADELPHIA B-31062, L-10567
PHOSPHATES A-29599, B-03129, D-03506

PHOSPHINE C-11123
PHOSPHORIC ACID B-09784
PHOSPHORUS COMPOUNDS A-29599, B-01508, B-02488, B-03129, C-11123, D-03506, F-26529
PHOTOCHEMICAL REACTIONS A-05007, A-16135, A-27451, A-30513, A-31759, A-33828, B-00504, B-06636, C-34279, D-24162, E-19849, K-11734, K-16263, L-03198
PHOTOGRAPHIC METHODS C-32268, F-33084, G-11476
PHOTOMETRIC METHODS A-30218, B-23319, C-04117, C-05426, C-24071, C-27248, C-28141, C-28393, C-32022, C-34279, C-34972, C-35949, G-00177
PHOTOOXIDATION B-06636
PHTHALIC ACID B-03966, B-07362, B-19493, B-24969

PHYSICAL STATES A-00393, A-05007, A-06981, A-09175, A-14580, A-20276, A-21395, A-22860, A-24527, A-26574, A-27972, A-28885, A-29455, A-32489, A-34228, A-35599, B-00358, B-00975, B-01505, B-01563, B-02427, B-04949, B-04952, B-04953, B-05408, B-05409, B-05532, B-05624, B-05808, B-05929, B-06088, B-06103, B-07362, B-07374, B-07531, B-08360, B-08467, B-08946, B-09655, B-09656, B-09661, B-09794, B-09836, B-09839, B-09840, B-09842, B-10005, B-10588, B-12346, B-15709, B-15779, B-16365, B-20369, B-20625, B-23002, B-23117, B-23493, B-25017, B-25085, B-25224, B-26125, B-27288, B-27719, B-28047, B-29323, B-29363, B-29533, B-30773, B-31091, B-32847, B-33742, C-07214, C-08354, C-08355, C-08356, C-08357, C-08358, C-08953, C-09521, C-09619, C-09620, C-09648, C-09657, C-09660, C-10016, C-10593, C-10693, C-14197, C-15287, C-23106, C-27475, C-28787, C-29858, C-32467, C-35648, D-01202, D-01949, D-07572, D-09592, F-10308, F-16455, F-16696, F-19102, G-05942, G-05946, G-05949, G-06323, G-21125, I-05463, K-05947, K-20194, K-21083, K-21084, L-32382, L-33672
PHYTOTOXICANTS B-00571, B-32682
PILOT PLANTS A-25056, A-25228, B-06636, B-08360, B-09733, B-11009, B-21647, B-22435, B-26173, B-27605, B-29251, B-32057, B-33077
PINTO BEANS D-09590
PITTSBURGH A-35693
PLANNING AND ZONING A-26911, B-26087, B-31453, D-03431, D-25291, K-07766, K-11734, K-21084, L-00973, L-01604, L-07235, L-09677, L-15691, L-17258, L-32352, L-33725, M-24091
PLANS AND PROGRAMS A-00402, A-02765, A-11700, A-12832, A-12834, A-16058, A-17198, A-23313, A-23314, A-24350, A-25638, A-26826, A-29698, A-31263, A-31323, A-32465, B-00504, B-00975, B-01505, B-01672, B-01867, B-02794, B-03129, B-07971, B-16842, B-25479, B-26087, B-30865, B-31178, B-32057, C-03010, C-04117, C-11167, C-27248, C-30374, D-00751, D-01202, D-01949, D-02212, D-02331, D-02339, D-03001, D-03017, D-03418, D-03431, D-03459, D-03506, D-03514, D-05481, D-06535, D-09590, D-09592, D-12426, D-12648, D-16062, D-23411, D-23845, D-25291, D-25780, D-25996, D-29973, D-31371, D-33539, D-35764, G-28175, K-00157, K-11734, K-31968, L-00054, L-00549, L-00871, L-01604, L-02295, L-02840, L-03540, L-04841, L-04888, L-04942, L-06732, L-07235, L-09677, L-10567, L-14616, L-15691, L-17258, L-19059, L-25446, L-26940, L-27184, L-27185, L-28348, L-29679, L-29813, L-30688, L-32147, L-32352, L-32354, L-34256, L-34755, M-00376, M-00487, M-00844, M-13980, M-23408, M-24091, M-24768, M-27680, M-31071, N-03438, N-32254
PLANT DAMAGE A-00402, A-02765, A-22973, A-26911, A-31759, A-33828, A-34018, A-35581, A-35622, B-00975, B-02427, B-26087, D-09590, D-09592, D-25780, D-33108, D-35764, E-19849, G-35570, H-20028, K-31968, L-03198, L-25446, L-32566, L-34926, N-19060
PLANTS (BOTANY) A-17236, A-19814, A-34018, A-35564, A-35581, B-00975, B-04943, B-09407, B-09655, B-17637, B-22061, C-08066, D-00751, D-03017, D-09590, D-09592, D-33108, G-00177, G-21125, K-11734, L-03198, N-03438
PLASTICS A-03825, A-10699, A-26575, A-29353, A-30687, B-01537, B-02047, B-03129, B-06525, B-09830, B-09836, B-09840, B-14609, B-15170, B-22988, B-26568, B-32119, B-32497, B-35955, C-09521, C-34863, D-00690, D-01949, D-09590, G-00208, M-01069
PLATING B-09784, L-27185
PLATINUM B-03499, B-05929, B-07362, B-27154, B-28206, B-31400, B-33742, B-33816
PLUME BEHAVIOR A-03097, A-14972, A-29353, A-32489, B-00975, B-01672, B-04838, B-07415, B-09608, B-10277, C-22958, D-09592, E-26550, L-04888
PNEUMOCONIOSIS B-25479
PNEUMONIA A-31759, L-03198
POINT SOURCES D-00690, D-09590
POLAROGRAPHIC METHODS B-03966, C-27248, C-35956
POLLENS A-34018, A-35564, B-19221, B-21006
POLLUTION PRECURSORS B-00975, K-11734
POLYMERIZATION F-23187
POLYNUCLEAR COMPOUNDS A-01565, A-07089, A-08802, A-11692, A-29599, A-33564, A-34018, A-34964, A-35635, B-02725, B-06280, B-08497, B-14203, B-17906, B-24969, B-24988, B-29533, C-03354, C-03542, C-06112, C-09476, C-09521, C-27121, C-32269, C-35956, D-00251, D-33539, L-14616, L-34926
PORTABLE B-06366, C-03010, C-08358, C-13367, C-21858
POTASSIUM COMPOUNDS A-08912, B-03297, B-03972, B-04627, B-06363, B-07531, B-09849, B-11234, B-32166, B-32646, F-13107
POTENTIOMETRIC METHODS B-00379, B-04045, B-08364, C-23755, C-35956
POULTRY A-30389, A-33713, B-14453, B-25379, B-25858, B-33120, B-33398, B-35879, C-13749
POWER SOURCES A-00393, A-01565, A-05007, A-05335, A-05527, A-05549, A-05608, A-06039, A-08802, A-09255, A-11692, A-12377, A-12505, A-14116, A-14297, A-14914, A-15297, A-20101, A-20118, A-20125, A-20134, A-20553, A-20557, A-21700, A-25327, A-25455, A-26048, A-27129, A-27249, A-27451, A-27986, A-28352, A-30327, A-30603, A-30851, A-31759, A-32653, A-33564, A-33648, A-33719, A-34018, A-34766, A-34891, A-34964, A-35590, A-35635, B-00504, B-01613, B-01867, B-05490, B-06280, B-06453, B-06525, B-06636, B-06979, B-07224, B-07362, B-07479, B-07971, B-08497, B-08604, B-08663, B-09608, B-11220, B-11234, B-12133, B-17906, B-20120, B-20877, B-20878, B-21220, B-23067, B-24845, B-24988, B-29437, B-29533, B-30865, B-31167, B-31400, B-31631, C-02786, C-03542, C-05170, C-07266, C-14606, C-14607, C-14680, C-16442, C-16781, C-20100, C-21693, C-22448, C-26966, C-27121, C-27934, C-29337, C-31924, D-00241, D-00251, D-00373, D-02331, D-09592, D-18231, D-24162, G-21125, G-34667, K-00157, K-07766, K-16263, L-00054, L-03198, L-04841, L-04888, L-05129, L-09215, L-09677, L-12376, L-35511, M-23408
PRECIPITATION A-30218, A-30513, B-16842, D-01202, D-02331, D-09590, D-09592, D-27255, D-31760, L-00054, L-14616, M-27680
PRESSURE A-01885, A-02001, A-05549, B-02729, B-04045, B-08497, B-09836, B-20824, B-22357, B-23002, B-25017, B-29278, B-29323, B-32937, B-34778, C-35956
PRESSURE (ATMOSPHERIC) B-09836, C-08678, G-06323
PRIMARY METALLURGICAL PROCESSING A-20134, A-20553, A-21887, A-26402, A-26574, A-30513, A-32489, B-00975, B-04227, B-05532, B-09784, B-09791, B-13551, B-17293, B-24743, B-25017, B-26254, B-30124, B-31178, B-31223, C-26966, C-35956, D-03459, D-09590, D-29973, L-00973, L-07235, L-09677, L-27185, L-29813, L-31084, M-14491
PRINTING A-25179, B-04533, B-05929, B-11137, B-14757, B-16498, B-34679, C-05614, C-22958, D-03431
PROCESS MODIFICATION A-07561, A-10075, A-10699, A-14297, A-24007, A-26911, A-27249, A-27986, A-28861, A-30603, A-33883, A-34290, A-34585, A-34654, A-34891, B-00025, B-00032, B-00358, B-01508, B-04045, B-04361, B-04781, B-04783, B-04838, B-04951, B-05852, B-05862, B-06106, B-07530, B-08360, B-09656, B-09827, B-09830, B-09933, B-10009, B-11153, B-11158, B-16498, B-16807, B-17409, B-17636, B-20824, B-21051, B-22522, B-23117, B-23371, B-23836, B-23885, B-25554, B-26730, B-26731, B-27288, B-27541, B-27732, B-27818, B-31062, B-31091, B-31453, B-31631, B-32119, B-32302, B-32498, B-32615, B-32646, B-32900, B-32937, B-33077, B-33617, B-33793, B-33854, B-34679, B-34868, B-35566, B-35803, C-25065, D-00209, D-09592, I-19325, K-07766, L-07235
PROPANES A-27249, A-28352, B-32956, C-05170, C-07214, D-00251
PROPENES A-32475, C-07214, D-00251
PROPIONALDEHYDES G-00177
PROPOSALS A-16058, B-01867, B-06280, D-03418, D-06535, D-25780, L-00871, L-35511
PROTEINS B-03297, C-29508, C-32268, C-32880, F-29649, G-07821, G-21359, G-23298
PUBLIC AFFAIRS A-14972, A-24350, A-26911, A-27669, A-28295, A-30687, A-30851, A-31263, A-32855, B-00032, B-00975, B-01352, B-05862, B-08360, B-24380, B-25479, B-29761, B-33077, C-00178, C-05614, C-05898, C-08678, C-09660, C-12479, D-00751, D-01202, D-02339, D-03017, D-03431, D-06535, D-09592, D-17630, D-23149, D-23152, D-29973, D-33539, G-00208, G-28175, J-34518, L-00054, L-00871, L-01604, L-07235, L-10484, L-14616, L-23754, L-26940, L-27184, L-27185, L-29679, L-29975, L-30153, L-30688, L-32147, L-32352, L-32796, M-00376, M-00487, M-00844, M-01069, M-08698, M-13980, M-14491, M-15760, M-23408, M-27680, M-30896, N-01539, N-03438

PUBLIC INFORMATION A-26911, L-07235, L-14616, L-29679, L-32147
PULMONARY EDEMA G-07821, H-00252, K-27403
PULMONARY FUNCTION D-27255, L-03198
PULSE RATE G-05942, G-21712
PYRENES A-01565, A-08802, A-34018, B-02725, B-08497, B-24988, B-29533, C-03542, C-32269, D-00251, D-33539
PYRIDINES A-07089, B-04627, C-08066, C-11123, C-27934, C-32269
PYROLYSIS A-04879, A-06981, A-08359, A-28885, A-32411, A-34766, B-00358, B-05532, B-11673, B-12506, B-20258, B-23117, B-25977, B-26014, B-26730, B-26731, B-32768, B-33120, B-35566, C-08354

Q

QUESTIONNAIRES A-22860, A-28295, A-31263, B-31178, D-01202, D-02331, D-23098, D-23149, D-23152, G-00208, G-28175, L-30153, M-00487, M-00644, M-01069, M-23408, M-27680, M-31071, N-03438
QUINONES B-19493, B-24969

R

RABBITS G-07821, G-19599
RADIATION MEASURING SYSTEMS C-28787, C-35956, G-00177
RADIOACTIVE RADIATION A-03097, A-09175, B-32070, C-18093, C-35956, L-32147
RADIOACTIVE TRACERS C-18093, L-32147
RADIOGRAPHY D-27255
RADIOSONDES A-03097
RAIN A-30218, A-30513, B-16842, D-27255, L-14616, M-27680
RATS C-12359, G-05949, G-07821, G-19599, G-23298, G-35671, K-05947, K-20194, K-21084
REACTION KINETICS A-01885, A-32411, B-04952, B-04953, B-05808, B-09655, B-26730, B-26731, B-29131, B-29978, E-19849, F-07681, F-12662
REACTION MECHANISMS A-01885, A-04893, A-32411, A-33983, B-03807, B-04887, B-04950, B-04953, B-06636, B-11234, B-15772, B-16890, B-20258, B-29131, B-33122, C-[illegible]353, C-24814, F-07681, F-29649, G-07821
RECOMBINATION B-11673, F-16828
RECORDING METHODS B-08360, C-32268, F-33084, G-11476, G-19599
REDUCTION B-00379, B-06106, B-07362, B-08361, B-31794, B-33122, F-10308, G-07821
REFRACTORIES A-25056, A-26575, B-09830, B-10009, B-33742
REGIONAL GOVERNMENTS A-28295, B-29628, D-09590, D-35764, L-09604, L-17258, L-25446, L-27185, L-27677, L-27678, L-27679, L-28348, L-28363, L-29679, L-29813, L-30153, L-32352, L-33117, L-33725, M-24091
REGULATIONS A-03097, A-08912, A-23313, A-23314, A-25638, A-27821, A-34585, B-00975, B-01505, B-03129, B-06280, B-09784, B-10277, B-27732, B-30260, B-31062, B-32559, B-33854, C-03010, C-25054, D-03001, D-25291, F-25761, K-07766, K-15926, K-31516, L-00973, L-01528, L-02294, L-02295, L-02840, L-07235, L-07781, L-09215, L-09604, L-09677, L-10567, L-12376, L-12511, L-14028, L-14616, L-14932, L-15554, L-15688, L-16330, L-19059, L-26940, L-27184, L-27677, L-27678, L-27679, L-28363, L-29679, L-30149, L-30688, L-32171, L-32352, L-32354, L-32382, L-32383, L-32566, L-32626, L-33672, L-33725, L-34033, L-34755, M-24091, N-03438
REINLUFT PROCESS (ADSORPTION) B-26908, B-32070
RENDERING A-04860, A-19899, A-20553, A-20706, A-21887, A-22973, A-28527, A-29599, B-02794, B-03972, B-04627, B-05093, B-06103, B-06412, B-09784, B-09791, B-09794, B-09852, B-09854, B-12346, B-20824, B-23002, B-25977, B-26014, B-26128, B-26567, B-26843, B-29601, B-29745, B-31062, B-32166, B-32646, B-32682, B-32781, B-33816, B-35595, C-06381, C-08066, C-10534, C-17628, C-20192, D-00751, D-02331, D-17630, K-07766, L-09677, L-19059, L-23754, L-30149, M-27680
RESEARCH INSTITUTES K-31286, L-35511
RESEARCH METHODOLOGIES B-23008, C-00178, C-09364, C-14109, C-21693, C-29891, C-30689, C-35182, D-00209, F-03173, M-00376, M-00487, M-00844
RESEARCH PROGRAMS A-26911, A-30851, A-35622, B-00504, B-04882, B-06636, B-08364, B-19850, B-34868, C-29891, G-34667, L-01528, L-03540, L-04841, L-04888, L-06732, L-22343, L-28348, L-29679, L-30688, L-34256, L-34926, L-35511
RESIDENTIAL AREAS A-17198, B-08360, B-26618, D-09590, D-24162, D-31371, L-00054, L-07235, L-09677, L-10567, L-29813, L-30149, L-32352, N-01539
RESIDUAL OILS B-09836, D-01949, D-09592, D-33108, K-31968, L-29813
RESPIRATION B-09407
RESPIRATORY DISEASES A-17603, A-22973, A-30389, A-30513, A-30687, A-31759, A-34018, B-08497, B-25479, C-08678, D-02212, D-33108, G-07821, G-27137, G-28175, G-34686, G-35570, H-00252, K-27403, K-35146, L-01604, L-03198, L-14616, L-34256, M-14491
RESPIRATORY FUNCTIONS B-08104, B-34778, C-08678, C-09648, C-35956, D-00373, D-02339, D-27255, D-29973, D-31371, G-05942, G-05946, G-07821, G-21712, K-05947, L-03198
RESPIRATORY SYSTEM A-00402, B-06280, B-31400, B-31700, C-05898, C-08066, C-08678, C-21693, C-32676, C-34972, D-25780, F-03173, F-11132, F-35651, G-05942, G-05946, G-06323, G-07821, G-09659, G-20969, G-21359, G-23298, G-35570, G-35671, H-00252, K-11734, K-35146, M-00376, N-05235
RETENTION B-05532, C-08357
RHODE ISLAND L-09677
RINGELMANN CHART A-08912, B-00504, B-00975, B-09784, B-22353, B-32913, C-04117, C-32022, K-31516, L-00973, L-09604, L-09677, L-10567, L-19059, L-32171, L-32352, L-32382, L-32626, L-35694
RIVERS A-07089, B-27605, D-03514, D-09590, G-07091
ROTARY PISTON ENGINES A-27249
RUBBER A-03825, A-35383, B-00032, B-04227, B-09784, B-09815, B-09830, B-09840, B-14956, B-15170, C-11486, D-09590, E-19849
RUBBER MANUFACTURING B-00032, B-00257, C-08066, D-23149, K-21083
RUNNING EVAPORATIVE LOSSES A-05007

S

SALTZMAN METHOD A-05549, C-27248, C-29337, C-30014, K-27403
SAMPLERS A-10075, A-28614, A-33188, A-33564, A-34964, B-00975, B-01505, B-03966, B-12434, B-23885, B-25623, B-30773, B-30809, B-32799, B-33073, B-33077, C-01289, C-03010, C-03789, C-05426, C-06526, C-08066, C-08358, C-09521, C-09619, C-09657, C-09860, C-10693, C-15287, C-20192, C-20460, C-23107, C-35956, D-00251, D-00690, D-01949, D-02212, D-03514, D-05481, D-09590, D-31760, F-10308, G-00177, I-05463, L-00054, L-02840, N-03438
SAMPLING METHODS A-00393, A-00525, A-04785, A-05549, A-05608, A-07089, A-09175, A-10075, A-10699, A-14580, A-17632, A-17633, A-20101, A-27451, A-28614, A-29698, A-30218, A-33188, A-33564, A-33713, A-34964, A-35622, B-00975, B-01414, B-01505, B-03966, B-04882, B-04887, B-05490, B-05808, B-06366, B-06525, B-09784, B-10277, B-12434, B-13971, B-14013, B-14967, B-16842, B-21006, B-23885, B-25623, B-30773, B-30809, B-32099, B-32166, B-32646, B-32681, B-32799, B-33073, B-33077, C-00965, C-01289, C-02786, C-03010, C-03542, C-03789, C-04117, C-04883, C-05426, C-05503, C-05614, C-06112, C-06526, C-08066, C-08355, C-08356, C-08358, C-09521, C-09619, C-09620, C-09657, C-09860, C-10016, C-10534, C-10593, C-10693, C-12492, C-13969, C-14197, C-15287, C-16781, C-17628, C-17629, C-19051, C-20192, C-20460, C-20538, C-23004, C-23107, C-24814, C-25065, C-26547, C-29726, C-29858, C-30689, C-32022, C-34279, C-34863, C-35541, C-35865, C-35956, D-00209, D-00241, D-00251, D-00690, D-01949, D-02212, D-03514, D-05481, D-09590, D-31760, F-10308, G-00177, G-03788, I-05463, K-27403, K-31516, L-00054, L-00871, L-01604, L-02840, L-03198, L-04841, L-10484, L-32566, L-33672, N-03438
SAMPLING PROBES A-05549, A-30218, C-03789, C-09860, C-20538, C-35956
SAN FRANCISCO A-35693, B-16890, B-32559, L-00973, L-09677
SCATTERING (ATMOSPHERIC) E-19849
SCRAP YARDS A-34228
SCREEN FILTERS B-32847, B-32935, B-35955
SCRUBBERS A-00525, A-04860, A-08912, A-09853, A-11651, A-12621, A-17603, A-17634, A-22987, A-24903, A-25205, A-25228, A-26402, A-27972, A-28614, A-29353, A-29599, A-30687, A-32879, A-33188, A-35590, B-00025, B-00358, B-00552, B-00571, B-00975, B-01352, B-01505, B-01549, B-01672, B-01900, B-02047, B-02279, B-02427, B-02488,

B-03499, B-03807, B-03966, B-03976, B-04227, B-04627, B-04664, B-04669, B-04773, B-04781, B-04783, B-04882, B-04943, B-04949, B-05332, B-05862, B-05880, B-05930, B-06106, B-06363, B-06412, B-06525, B-06859, B-07374, B-07415, B-07429, B-07434, B-07530, B-07531, B-08360, B-08364, B-09508, B-09656, B-09733, B-09784, B-09813, B-09815, B-09819, B-09849, B-09852, B-09854, B-09922, B-10005, B-10277, B-10588, B-11008, B-11158, B-12482, B-13334, B-13551, B-13772, B-14094, B-14118, B-14671, B-14687, B-15690, B-15709, B-15779, B-16365, B-16807, B-16842, B-18140, B-18169, B-19493, B-19705, B-20709, B-20817, B-21051, B-21647, B-21677, B-22357, B-22400, B-23117, B-23371, B-23901, B-23967, B-24380, B-24969, B-25017, B-25085, B-25479, B-26002, B-26014, B-26173, B-26176, B-26843, B-29251, B-29261, B-29363, B-29745, B-30062, B-30124, B-30350, B-30530, B-30738, B-30773, B-31062, B-31160, B-31167, B-31302, B-31400, B-31456, B-31472, B-31790, B-31945, B-32166, B-32615, B-32634, B-32646, B-32768, B-32781, B-32847, B-32900, B-32956, B-33003, B-33120, B-33122, B-33380, B-34385, B-34778, B-35554, B-35595, B-35660, B-35803, C-00965, C-03010, C-05614, C-27791, C-31924, D-00209, D-00373, D-09592, G-00177, J-16457, J-34518, L-04942, L-29813, M-31071
SEA BREEZE D-00690
SEALING COMPOUNDS A-34585, B-09840
SEALS B-09836, B-09840
SEASONAL A-03097, A-24500, A-27669, B-01672, B-32900, C-05503, D-00690, D-01949, D-03431, D-03514, D-09592, D-17630, D-23845, D-27255, D-31371, K-35146, M-01069
SECONDARY AIR A-34290, B-04783, B-09827, B-27541, B-32302, B-32937, D-09592
SEDIMENTATION B-07429, B-09784, B-09839, B-31945, B-35955, C-03010
SELENIUM COMPOUNDS F-14987
SETTLING CHAMBERS A-33188, B-05852, B-25017, B-32634, L-32352
SETTLING PARTICLES A-02001, A-07394, A-07561, A-08373, A-08912, A-09175, A-09853, A-10075, A-10699, A-12621, A-14297, A-14972, A-17633, A-20134, A-21882, A-22860, A-24500, A-24903, A-25056, A-25205, A-25638, A-26574, A-26911, A-27669, A-29332, A-29353, A-30389, A-32385, A-32489, A-32653, A-33188, A-33648, A-33719, A-34018, A-35564, B-00025, B-00975, B-02279, B-03976, B-04227, B-04361, B-04949, B-05930, B-06280, B-06859, B-07429, B-07479, B-07875, B-07971, B-08104, B-09407, B-09655, B-09733, B-09784, B-09813, B-09815, B-09830, B-09849, B-09852, B-09854, B-10009, B-13551, B-13697, B-14094, B-14951, B-14956, B-16842, B-17403, B-19221, B-19363, B-20817, B-21006, B-21647, B-22357, B-23319, B-23493, B-23885, B-24380, B-24810, B-26254, B-26296, B-26568, B-27288, B-29323, B-29363, B-29437, B-29533, B-29761, B-30479, B-30530, B-31160, B-31167, B-31233, B-31301, B-31354, B-31456, B-31472, B-31631, B-31945, B-32634, B-32682, B-32847, B-32956, B-33120, B-35803, B-35955, C-03010, C-04117, C-21208, C-23107, D-00251, D-01949, D-02212, D-03431, D-03459, D-03514, D-05481, D-09590, D-09592, D-12648, D-16636, D-23411, D-25291, D-29973, D-33108, D-35764, E-26550, J-16457, K-07766, K-31968, K-35146, L-01528, L-02840, L-04942, L-07235, L-07781, L-09604, L-09677, L-14616, L-15691, L-17258, L-19059, L-26511, L-27184, L-27185, L-27677, L-27678, L-27679, L-28363, L-29679, L-29813, L-29975, L-30149, L-30153, L-31084, L-32171, L-32352, L-32383, L-32626, L-35511, M-00376
SEWAGE A-04785, A-17462, A-17603, A-20553, A-25056, A-25228, A-26574, A-29353, A-29599, A-31602, A-32385, A-32855, B-00541, B-01508, B-01563, B-03972, B-04666, B-09729, B-09839, B-09922, B-13697, B-14940, B-15948, B-18153, B-19705, B-20754, B-22538, B-23594, B-25623, B-25694, B-26125, B-27336, B-28146, B-29251, B-30530, B-32498, B-32768, B-32935, B-33003, B-33120, B-33380, B-33793, B-34073, C-05503, C-08066, C-26966, C-31222, D-02339, D-03418, H-00252, J-16457, L-15691, L-32796, L-33117
SEWAGE TREATMENT A-04785, A-29353, A-29599, A-31602, A-32855, B-00541, B-01508, B-01563, B-03972, B-04666, B-09729, B-09839, B-13697, B-14940, B-15948, B-18153, B-19705, B-22538, B-23594, B-27336, B-32768, B-33003, B-33120, B-33380, B-33793, C-05503, D-02339, J-16457, L-32796, L-33117
SEWERS B-04666, B-20754, B-23594, D-03418
SHEEP B-25858
SHIPS D-00373, L-35694
SILICATES B-09784
SILICON COMPOUNDS B-05808, B-09784, B-32070, B-32498, I-05463
SILICON DIOXIDE A-00402
SILVER COMPOUNDS A-34287, D-09590, D-09592
SIMULATION A-05007, A-11144, A-25455, B-00286, B-05490, B-09608, C-29508, C-35182, D-18231, G-00177, L-35511, N-05235
SINGLE CHAMBER INCINERATORS A-07561, A-29455, A-34654, B-09830
SINTERING B-04227, B-13551
SKIN F-11132, F-19102, G-19599, G-21712, N-05235
SLAUGHTERHOUSES A-21887, A-24350, A-26911, A-30389, A-34018, B-05624, B-06412, B-09852, B-09854, B-21677, B-26254, B-27548, B-29745, B-32781, B-33120, C-31924, C-33577, D-17630, L-32893, L-33117
SLUDGE A-04785, A-17462, A-25056, A-26574, A-29353, A-31602, A-32385, B-13697, B-14940, B-25694, B-28146, B-29251, B-30530, B-32935, B-33120, B-33793, B-34073, C-08066, J-16457
SMOG A-24459, A-31759, A-33828, A-35693, B-00504, B-00975, B-02427, B-14895, B-17906, B-19218, B-30865, D-00241, D-24162, D-25291, E-19849, G-00177, K-00157, K-18294, L-01528, L-03198, L-34256, M-01069
SMOKE SHADE A-05335, A-08912, A-10075, B-00504, B-00975, B-06280, B-09784, B-22353, B-32913, C-04117, C-29337, C-32022, D-00690, D-03017, K-31286, K-31516, L-00973, L-09604, L-09677, L-10567, L-15688, L-19059, L-32171, L-32352, L-32382, L-32626, L-35694
SMOKEMETERS A-10075, A-34891, A-35635, B-05490, B-06280, B-06979, B-09608, B-20120, B-20877, B-20878, B-24988, C-20100, C-32022, L-03198, L-04841, L-04942
SMOKES A-02001, A-05007, A-05335, A-05527, A-06039, A-07394, A-07561, A-08373, A-08802, A-08912, A-09175, A-09853, A-10075, A-10699, A-12083, A-12377, A-12505, A-14116, A-14914, A-16058, A-17462, A-20101, A-20125, A-20276, A-22860, A-23313, A-26048, A-26575, A-26605, A-27129, A-27235, A-27249, A-27669, A-27821, A-27986, A-28614, A-28861, A-29353, A-30603, A-31323, A-32489, A-32653, A-34228, A-34290, A-34654, A-34891, A-35383, A-35564, A-35693, B-00246, B-00975, B-01613, B-01867, B-04361, B-04533, B-05490, B-05852, B-05930, B-06280, B-06453, B-06525, B-06636, B-06979, B-07224, B-07479, B-07971, B-08497, B-08663, B-08946, B-09608, B-09791, B-09813, B-09827, B-09830, B-09852, B-11220, B-11234, B-14609, B-14895, B-14951, B-14956, B-14967, B-20120, B-20877, B-20878, B-21220, B-23008, B-23067, B-23836, B-24090, B-24380, B-24845, B-24988, B-25554, B-26567, B-26568, B-26730, B-26731, B-26778, B-26908, B-27541, B-27548, B-27793, B-27818, B-29533, B-29761, B-30865, B-31233, B-31400, B-31453, B-31631, B-31700, B-32682, B-32847, B-32913, B-33077, B-33793, B-33854, B-34679, B-35554, B-35566, C-04117, C-11167, C-20100, C-29337, D-00241, D-00251, D-00690, D-00751, D-01202, D-03001, D-03017, D-03418, D-03431, D-03514, D-09592, D-23411, E-26550, K-07766, K-15926, K-16263, K-31286, K-31968, L-00973, L-01528, L-02840, L-04841, L-04888, L-04942, L-07235, L-09215, L-09604, L-09677, L-10567, L-12376, L-14616, L-15554, L-15688, L-15691, L-25446, L-27184, L-27185, L-27677, L-27678, L-27679, L-28363, L-29679, L-30149, L-30153, L-31084, L-32147, L-32352, L-35694
SMOKING B-07224, B-08104, B-31233, C-27934
SNOW D-09592
SOAP MANUFACTURING B-01505, B-05862, B-05930, B-07429, B-09784, B-09849
SOCIAL ATTITUDES A-20706, A-24350, B-19850, C-18194, D-06535, D-17630, G-34667, L-15691, L-29975, M-00376, M-00844, M-14491, M-23408, M-24091, M-26725, M-31071
SOCIO-ECONOMIC FACTORS A-20553, A-31155, A-32653, A-33828, A-35581, B-01672, B-29761, B-30260, B-31354, B-32099, C-29891, D-06535, D-33539, G-34667, L-26511, L-29975, L-34926, M-24768
SODIUM CARBONATE B-00025, B-04943, B-11008, D-09592
SODIUM CHLORIDE B-00025, B-32935

SODIUM COMPOUNDS A-11144, A-24903, A-35590, B-00025, B-00379, B-00571, B-04666, B-04783, B-04838, B-04887, B-04943, B-04953, B-06106, B-08360, B-08364, B-09655, B-09839, B-09849, B-10277, B-11008, B-11009, B-11234, B-16365, B-16747, B-20369, B-23538, B-29251, B-30339, B-30530, B-31072, B-32615, B-32646, B-32847, B-32935, B-34385, D-09592, F-11132, F-13107
SODIUM HYDROXIDE B-00025, B-00379, B-00571, B-04887, B-04953, B-09839, B-09849, B-16365, B-30530, B-32847, B-34385
SODIUM SULFITE A-11144, A-35590, B-00025, B-08364, B-23538, B-32615
SOILING A-03097, A-16058, A-34018, D-01949, D-03017, L-00871
SOILING INDEX B-00975, B-26087, D-00690, D-01202, D-03017, D-23411, K-07766, K-11734, L-01604, L-02840, M-01069, N-03438
SOILS A-17236, A-33883, A-35564, B-27336, B-32682, C-30704, D-31371, G-07091
SOLAR RADIATION A-05007, B-09836, D-01202, D-31760
SOLID WASTE DISPOSAL A-07561, A-08373, A-09175, A-11651, A-12832, A-12834, A-17236, A-17462, A-22860, A-23313, A-23314, A-24350, A-25638, A-26575, A-27821, A-27972, A-29332, A-29353, A-29455, A-30389, A-31155, A-31157, A-32385, A-32411, A-32855, A-34228, A-34290, A-34654, A-35383, A-35564, A-35599, A-35673, A-35693, B-00032, B-00975, B-04664, B-05852, B-06412, B-09784, B-09827, B-10009, B-14609, B-17403, B-19182, B-22435, B-22518, B-22550, B-23008, B-23836, B-25694, B-25977, B-26125, B-26254, B-26778, B-27732, B-29448, B-30124, B-30530, B-30773, B-31302, B-31453, B-32119, B-32497, B-32682, B-32913, B-33120, B-33816, B-33854, B-35595, B-35879, C-13099, C-13749, C-27791, C-35865, D-00373, D-01949, D-02331, D-02339, D-03017, D-03431, D-03506, D-09590, D-09592, D-17630, D-23411, D-25780, D-33539, E-26550, F-29649, K-07766, L-00054, L-00973, L-02840, L-09604, L-09677, L-32626, M-00844, M-24091
SOLIDS A-05007, A-26574, A-28885, B-05532, B-30773, C-08358, C-27475
SOLVENTS A-03825, A-21978, A-23843, A-24007, A-27235, A-29698, A-34585, B-02427, B-04943, B-05929, B-07362, B-09784, B-09791, B-09794, B-09813, B-09815, B-09857, B-11059, B-11136, B-11137, B-14757, B-14895, B-15170, B-16113, B-16498, B-16890, B-21294, B-22838, B-23117, B-23967, B-24197, B-26308, B-26944, B-27732, B-28047, B-31472, B-32956, B-34679, C-08066, C-08357, C-20538, D-02339, D-03431, D-33539, K-21084, L-07235, L-09677, L-14028
SOOT A-02001, A-08373, A-09175, A-10075, A-10699, A-14297, A-20134, A-22860, A-24500, A-27669, A-32653, A-33648, A-33719, B-04361, B-06280, B-07479, B-07971, B-09830, B-23885, B-29437, B-29533, B-31167, B-31631, B-32847, D-00251, D-33108, J-16457, L-04942, L-07235, L-07781, L-14616, L-27185, L-28363, L-29679, L-30149, L-30153
SOOT FALL D-26304
SOURCE SAMPLING A-09175, A-10699, A-17632, A-17633, A-20101, A-28614, A-30218, B-00975, B-13971, B-32646, B-32681, C-00965, C-03789, C-04117, C-19051, C-32022, C-34863, C-35956, D-31760, L-32566, L-33672
SOUTH CAROLINA D-03506
SO2 REMOVAL (COMBUSTION PRODUCTS) A-14297, A-25638, B-06636, B-08104, B-09508, B-09839, B-13551, B-15779, B-20369, B-20709, B-21647, B-22353, B-24969, B-25224, B-26908, B-28047, B-29437, B-29533, B-29628, B-30260, B-30350, B-31456, B-31463, B-31945, B-32070, B-32615, B-32913, B-35803, L-07235
SPACECRAFT ATMOSPHERES A-03825, A-21978
SPARK IGNITION ENGINES A-01565, A-05007, A-05549, A-05608, A-27249, A-28352, B-00504, B-01867, B-07224, B-08604, B-08663, B-11234, C-27934, D-24162, K-00157, L-00054, L-03198
SPARK TIMING A-27249, B-25594, B-28108
SPECTROMETRY A-03825, A-05549, A-08373, A-11692, A-19814, A-21978, A-23843, A-25455, A-29698, A-33564, A-34766, A-34964, A-35635, B-05408, B-05624, B-06363, C-02786, C-03354, C-03542, C-05426, C-07214, C-08066, C-10534, C-13143, C-14607, C-20100, C-20192, C-20264, C-22431, C-24814, C-27121, C-27248, C-27685, C-28141, C-28787, C-29337, C-29843, C-30374, C-34279, C-35956, D-00251, D-00373, D-03514, F-07681, F-14987, F-17801, F-19061, F-19063, G-00177, G-11476, I-05463
SPECTROPHOTOMETRY A-05549, A-21661, B-02279, B-03966, B-05408, B-06363, B-06453, B-24380, C-05426, C-29843, C-30014, C-35956, D-00251, G-35671, I-05463
SPOT TESTS A-08373, A-17603, B-29323
SPRAY TOWERS A-27972, B-00025, B-02047, B-02279, B-03976, B-04664, B-05862, B-07374, B-07415, B-07429, B-07530, B-07531, B-09508, B-09819, B-09852, B-10277, B-14671, B-24969, B-25017, B-29261, B-31160, B-31790, B-35554
SPRAYS B-03976
ST LOUIS A-01644, A-01885, A-02001, B-00257, B-00379, B-01414, B-01563, B-02725, B-02729, B-03966, B-03976, B-04045, B-05862, C-03354, C-03789, D-33539, K-07766, L-09677, L-30149
STABILITY (ATMOSPHERIC) A-03097, A-05007, A-11700, A-14972, A-16058, A-31759, A-33828, B-00975, B-01672, B-16842, B-26087, C-08066, C-25065, D-01202, D-01949, D-02331, D-03017, D-03418, D-03431, D-03506, D-09590, D-09592, D-12426, D-23411, D-25996, L-00054, L-02840, L-07235, M-08698, N-03438
STACK GASES A-02001, A-07561, A-09175, A-10075, A-17634, A-22860, A-24007, A-25179, A-25205, A-26402, A-26574, A-26575, A-26605, A-27235, A-28527, A-28614, A-28861, A-29353, A-30218, A-30687, A-32465, A-32489, A-32879, A-33883, A-33983, A-35638, B-00358, B-01672, B-03807, B-04227, B-04533, B-05332, B-05532, B-05930, B-06636, B-06859, B-07971, B-08360, B-09655, B-09656, B-09784, B-09813, B-09827, B-10009, B-10277, B-11009, B-11153, B-11158, B-13551, B-13772, B-13971, B-14094, B-14203, B-14609, B-14895, B-14956, B-15690, B-16747, B-17403, B-19218, B-19363, B-19850, B-20817, B-20824, B-22061, B-22353, B-22400, B-22522, B-22525, B-23836, B-25017, B-25950, B-26173, B-26176, B-26568, B-26618, B-27541, B-27548, B-27732, B-27793, B-28206, B-28756, B-29251, B-29363, B-29628, B-29761, B-30062, B-30260, B-30350, B-31091, B-31223, B-31301, B-31453, B-31456, B-31463, B-31700, B-31790, B-31911, B-31945, B-32070, B-32119, B-32615, B-32781, B-32900, B-32913, B-32956, B-33077, B-34385, B-35554, B-35803, C-01289, C-03010, C-04117, C-04883, C-05898, C-06112, C-09476, C-09648, C-09657, C-09660, C-19051, C-22958, C-32022, C-34863, C-35956, D-00209, D-07572, D-09592, D-16062, D-29973, D-33723, F-10308, F-25761, I-19325, J-16457, K-15926, K-31516, L-01528, L-07235, L-09677, L-10567, L-14798, L-15554, L-15691, L-27184, L-27678, L-27679, L-28348, L-30149, L-31084, L-32626, L-33672, L-35511, N-19060, N-19088
STACK SAMPLING A-09175, A-10699, A-17632, B-00975, B-13971, B-32681, C-00965, C-03789, C-04117, C-19051, C-34863, C-35956, L-33672
STACKS A-06240, A-07394, A-17462, A-22860, A-25638, A-27235, A-29353, A-29599, A-31882, A-35599, A-35638, B-01352, B-02729, B-04838, B-05332, B-08946, B-09827, B-09830, B-10005, B-11153, B-13551, B-19493, B-22353, B-23371, B-25479, B-26618, B-27541, B-27793, B-28108, B-28118, B-31223, B-32900, C-00965, C-03010, C-06112, C-22958, C-32676, C-35956, D-16062, D-29973, D-35764, L-07235, L-09604, L-27678, L-27679, L-29813, L-31084, L-32352
STAGNATION C-25065, D-01202, D-03431, D-03506, D-09590, D-12426, D-23411, L-02840, N-03438
STANDARDS A-05335, A-21882, A-23843, A-24500, A-25205, A-25638, A-27821, A-28861, A-29353, A-30603, A-31759, A-32878, A-33719, A-34290, A-34585, B-00504, B-00552, B-00975, B-03129, B-06280, B-09922, B-11059, B-23319, B-24988, B-25479, B-29323, B-29877, B-31062, B-31301, C-02786, C-04117, C-05614, C-05898, C-09716, C-14680, C-25065, C-32022, C-34279, D-01202, D-05256, D-16635, D-16636, D-18231, G-05942, G-05943, G-05946, G-05949, G-07821, G-21125, G-35570, K-00157, K-05117, K-05947, K-07766, K-11734, K-15926, K-16263, K-18294, K-20194, K-21083, K-21084, K-21918, K-27403, K-30870, K-31286, K-31516, K-31968, K-35146, L-00549, L-00871, L-00973, L-01604, L-03198, L-05129, L-07781, L-09604, L-09677, L-10567, L-12376, L-14616, L-14932, L-15688, L-19059, L-25446, L-27678, L-27679, L-29679,

L-29813, L-31465, L-32147, L-32171, L-32352, L-32382, L-32383, L-32566, L-32893, L-33117, L-33672, L-33725, L-34033, L-34755, L-35752, M-00376, M-00487, M-00844
STATE GOVERNMENTS A-23313, A-23314, A-25638, A-34290, B-00504, B-00975, B-01672, B-07971, B-16890, B-32057, D-01949, K-00157, K-11734, K-15926, L-00549, L-00871, L-09604, L-09677, L-12511, L-14028, L-15554, L-15691, L-23754, L-26940, L-32147, L-32354, L-32626, L-34256, L-34755, L-35694, N-03438, N-32254
STATISTICAL ANALYSES A-14116, C-05170, C-08268, C-26309, C-29508, C-32269, C-34178, C-35541, D-18231, D-33539, F-16696, L-04888, L-05129
STEAM B-05408, B-05409, B-05624, B-06103, B-07362, B-09656, B-15709, B-23117, B-25085, B-29533, B-32847, B-33742, D-09592
STEAM ENGINES A-30327, A-31759
STEAM PLANTS A-12832, A-24500, B-05880, B-07971, B-09784, B-10009, B-28108, D-09590, D-23411
STEEL B-04227, B-09836, B-10277, B-28756, D-09590, D-09592, D-29973, I-24187, L-00973, L-01604, L-29813
STOMACH G-21712
STONE K-31516, M-26725
STORAGE BATTERIES A-31759, L-35511

STREETS A-09255, D-24162, D-29973, K-18294
STRONTIUM COMPOUNDS B-11234
STUDENTS D-00751
STYRENES A-07089, B-04627, C-11123, C-11486, C-14109, C-15287, C-18093, D-23149
SULFATES A-06240, A-32489, B-00025, B-00379, B-01900, B-03807, B-04666, B-09839, B-09849, B-10277, B-19705, B-30339, C-25466, D-00209, D-09592, L-14616, M-01069
SULFIDES A-01644, A-01885, A-04879, A-04893, A-06240, A-08359, A-11144, A-12507, A-14580, A-16494, A-17603, A-17631, A-17633, A-20134, A-21857, A-25179, A-25228, A-28885, A-29599, A-31044, A-31263, A-32475, A-32489, A-32855, A-32879, A-34018, A-34287, A-35564, B-00025, B-00286, B-00379, B-00975, B-01414, B-01505, B-01508, B-01549, B-01563, B-01672, B-01900, B-02018, B-02279, B-02427, B-02488, B-03807, B-04045, B-04627, B-04664, B-04666, B-04773, B-04781, B-04783, B-04838, B-04861, B-04882, B-04887, B-04950, B-04951, B-04952, B-04953, B-05408, B-05409, B-05624, B-05808, B-05880, B-06106, B-06363, B-06859, B-07434, B-07531, B-07875, B-08360, B-08361, B-08364, B-08467, B-08946, B-09508, B-09655, B-09661, B-09839, B-09840, B-09854, B-09922, B-10277, B-10994, B-11008, B-11009, B-11673, B-13072, B-14094, B-14113, B-14118, B-14203, B-14488, B-15690, B-15779, B-16747, B-16807, B-16842, B-17293, B-17409, B-17637, B-18140, B-19218, B-19850, B-20625, B-20824, B-21051, B-22061, B-22400, B-22522, B-22837, B-22838, B-23117, B-23538, B-23594, B-23901, B-24380, B-25224, B-25623, B-25950, B-26014, B-26128, B-26173, B-26254, B-26618, B-26836, B-26908, B-28118, B-29278, B-29448, B-30062, B-30339, B-31072, B-31091, B-31302, B-31790, B-32615, B-32681, B-32798, B-32937, B-32956, B-33122, B-33380, B-34073, B-35803, C-00965, C-03354, C-04883, C-05426, C-05503, C-06112, C-06381, C-07214, C-08066, C-08268, C-08354, C-08355, C-08356, C-08357, C-08358, C-09619, C-09648, C-09657, C-10693, C-11123, C-13099, C-13749, C-14108, C-14109, C-17629, C-17638, C-17639, C-17640, C-19051, C-21652, C-21858, C-21859, C-24429, C-24814, C-26547, C-27355, C-27685, C-27791, C-27934, C-28787, C-29243, C-29269, C-29726, C-29843, C-30704, C-30811, C-31924, C-32467, C-34279, C-34863, C-35865, C-35956, D-00209, D-00690, D-01949, D-02339, D-03017, D-03514, D-06535, D-07572, D-09590, D-09592, D-12426, D-16062, D-16635, D-20355, D-23149, D-25996, D-29349, D-31371, D-33108, D-33723, E-22335, F-01784, F-10308, F-12662, F-14987, F-16828, F-29649, G-00208, G-03788, G-05943, G-09659, H-00252, K-07766, K-35146, L-00054, L-00871, L-02840, L-06732, L-07235, L-32352, L-32382, L-32796, M-00376, M-08698, N-19060
SULFITES A-25205, A-35590, B-07531, B-11009, B-26172, G-00177
SULFONIC ACID B-24969
SULFUR COMPOUNDS A-01644, A-01885, A-04785, A-04879, A-04893, A-06240, A-06981, A-08359, A-11144, A-12507, A-14580, A-16494, A-17603, A-17631, A-17633, A-20134, A-21857, A-23313, A-23314, A-25179, A-25205, A-25228, A-26048, A-26402, A-28885, A-29599, A-29842, A-31044, A-31263, A-32475, A-32489, A-32653, A-32855, A-32879, A-33719, A-33828, A-33883, A-34018, A-34287, A-34964, A-35564, A-35590, B-00025, B-00286, B-00379, B-00975, B-01414, B-01505, B-01508, B-01549, B-01563, B-01672, B-01900, B-02018, B-02279, B-02427, B-02488, B-03807, B-04045, B-04627, B-04664, B-04666, B-04773, B-04781, B-04783, B-04838, B-04861, B-04882, B-04887, B-04950, B-04951, B-04952, B-04953, B-05408, B-05409, B-05624, B-05808, B-05880, B-06106, B-06363, B-06636, B-06859, B-07434, B-07531, B-07875, B-08360, B-08361, B-08364, B-08467, B-08946, B-09508, B-09655, B-09656, B-09661, B-09836, B-09839, B-09840, B-09849, B-09854, B-09922, B-10277, B-10994, B-11008, B-11009, B-11673, B-13072, B-13398, B-14094, B-14113, B-14118, B-14203, B-14488, B-15690, B-15709, B-15772, B-15779, B-16747, B-16807, B-16842, B-17293, B-17409, B-17637, B-18140, B-19218, B-19705, B-19850, B-20258, B-20625, B-20824, B-21051, B-22061, B-22400, B-22522, B-22837, B-22838, B-23117, B-23538, B-23594, B-23901, B-24079, B-24380, B-25224, B-25623, B-25950, B-26014, B-26128, B-26172, B-26173, B-26254, B-26618, B-26836, B-26908, B-27674, B-27719, B-28118, B-29278, B-29448, B-30062, B-30339, B-30530, B-31072, B-31091, B-31302, B-31790, B-32615, B-32681, B-32798, B-32937, B-32956, B-33122, B-33380, B-34073, B-35803, C-00965, C-03354, C-04883, C-05426, C-05503, C-05813, C-06112, C-06381, C-06526, C-07214, C-08066, C-08268, C-08354, C-08355, C-08356, C-08357, C-08358, C-09619, C-09648, C-09657, C-10693, C-11123, C-13099, C-13367, C-13749, C-14108, C-14109, C-17629, C-17638, C-17639, C-17640, C-19051, C-21652, C-21858, C-21859, C-24429, C-24814, C-25466, C-26547, C-27248, C-27355, C-27475, C-27685, C-27791, C-27934, C-28141, C-28787, C-29243, C-29269, C-29726, C-29843, C-29858, C-30704, C-30811, C-31924, C-32467, C-33349, C-34279, C-34863, C-35865, C-35949, C-35956, D-00209, D-00690, D-01949, D-02339, D-03017, D-03514, D-05481, D-06535, D-07572, D-09590, D-09592, D-12426, D-16062, D-16635, D-20355, D-23149, D-25996, D-29349, D-31371, D-33108, D-33723, E-22335, F-01784, F-10308, F-12662, F-14987, F-16828, F-29649, G-00177, G-00208, G-03788, G-05943, G-09659, H-00252, K-07766, K-35146, L-00054, L-00871, L-00973, L-02840, L-06732, L-07235, L-09677, L-14616, L-32352, L-32382, L-32626, L-32796, M-00376, M-01069, M-08698, N-19060
SULFUR DIOXIDE A-00525, A-01565, A-05007, A-06240, A-07561, A-09175, A-09255, A-10075, A-12621, A-14297, A-20134, A-22973, A-23843, A-26402, A-26911, A-30218, A-30513, A-30603, A-31759, A-31882, A-32489, A-32653, A-32855, A-32879, A-34891, B-00025, B-00975, B-01505, B-01672, B-02018, B-02427, B-04361, B-04627, B-04783, B-04838, B-05332, B-05808, B-06280, B-06636, B-07530, B-07875, B-07971, B-08104, B-08364, B-08467, B-08497, B-09508, B-09830, B-09854, B-09933, B-11008, B-13551, B-14118, B-14671, B-14692, B-16747, B-19705, B-20817, B-22061, B-22522, B-22837, B-25479, B-26087, B-26908, B-27719, B-28108, B-30124, B-31062, B-31091, B-31233, B-31354, B-32070, B-32302, B-32681, B-32956, B-33077, B-33854, C-00965, C-03010, C-03542, C-04883, C-05426, C-05503, C-08066, C-08355, C-08356, C-08358, C-09476, C-09619, C-09657, C-11123, C-14109, C-16781, C-19051, C-23107, C-27934, C-29843, C-30014, C-34279, C-34863, C-35949, D-00251, D-01949, D-03001, D-03017, D-03506, D-03514, D-05481, D-07572, D-09590, D-09592, D-16636, D-23411, D-23845, D-25780, D-25996, D-29973, D-31371, D-31760, D-33108, E-19849, E-22335, E-26550, F-01784, F-23187, F-25761, G-00177, G-346[illegible], H-20028, J-34518, K-05947, K-07766, K-31516, K-31968, K-35146, L-00054, L-00973, L-01528, L-01604, L-02840, L-04942, L-07235, L-09677, L-14616, L-25446, L-26511, L-27184, L-27185, L-28348, L-29679, L-29813, L-31084, L-32171, L-32352, L-32382, L-33672, M-01069, M-08698, M-24091, M-31071, N-03438, N-19060, N-20495, N-32254
SULFUR OXIDES A-00525, A-01565, A-05007, A-06240, A-07561, A-09175, A-09255, A-10075, A-12621, A-14297, A-17633, A-20134, A-22973, A-23843,

A-24500, A-25205, A-26402, A-26911, A-30218, A-30513, A-30603, A-31759, A-31880, A-31882, A-32465, A-32489, A-32653, A-32855, A-32879, A-33719, A-33828, A-33883, A-34018, A-34891, B-00025, B-00975, B-01505, B-01508, B-01672, B-02018, B-02427, B-04361, B-04627, B-04783, B-04838, B-05332, B-05808, B-05880, B-06280, B-06636, B-07530, B-07875, B-07971, B-08104, B-08364, B-08467, B-08497, B-08663, B-09508, B-09784, B-09830, B-09854, B-09933, B-11008, B-13551, B-14118, B-14671, B-14692, B-16747, B-19705, B-20817, B-22061, B-22522, B-22837, B-23008, B-24743, B-25479, B-26087, B-26254, B-26908, B-27719, B-28108, B-30124, B-31062, B-31091, B-31233, B-31354, B-32070, B-32302, B-32681, B-32956, B-33077, B-33854, C-00965, C-03010, C-03542, C-04883, C-05426, C-05503, C-06112, C-08066, C-08355, C-08356, C-08358, C-09476, C-09619, C-09657, C-11123, C-14109, C-16781, C-19051, C-23107, C-27248, C-27934, C-29843, C-30014, C-34279, C-34863, C-35949, C-35956, D-00251, D-01949, D-03001, D-03017, D-03506, D-03514, D-05481, D-06535, D-07572, D-09590, D-09592, D-16636, D-23411, D-23845, D-25291, D-25780, D-25996, D-26304, D-27255, D-29973, D-31371, D-31760, D-33108, D-33539, D-33723, D-35764, E-19849, E-22335, E-26550, F-01784, F-16828, F-23187, F-25761, G-00177, G-34686, H-20028, I-19325, J-34518, K-05947, K-07766, K-31516, K-31968, K-35146, L-00054, L-00973, L-01528, L-01604, L-02840, L-04942, L-07235, L-09677, L-12511, L-14616, L-14798, L-17258, L-19059, L-25446, L-26511, L-27184, L-27185, L-27677, L-27678, L-27679, L-28348, L-29679, L-29813, L-31084, L-32147, L-32171, L-32352, L-32382, L-33672, M-01069, M-08698, M-24091, M-31071, N-03438, N-19060, N-20495, N-32254

SULFUR OXIDES CONTROL A-14297, A-25638, A-31759, A-33883, B-06636, B-08104, B-09508, B-09839, B-13551, B-15779, B-17266, B-20369, B-20709, B-21647, B-22353, B-24969, B-25224, B-26618, B-26908, B-28047, B-28118, B-29437, B-29533, B-29628, B-30260, B-30350, B-31456, B-31463, B-31945, B-32057, B-32070, B-32615, B-32900, B-32913, B-32956, B-33854, B-35803, D-33723, D-35764, F-01784, K-07766, L-07235, L-22343

SULFUR TRIOXIDE A-09175, A-30218, A-32489, B-01505, B-04838, B-07971, B-20817, B-31091, C-34279, K-07766, K-35146, L-32352, L-32382

SULFURIC ACID A-32855, B-03129, B-07531, B-09784, B-09839, B-26254, B-29363, B-31091, B-31233, C-03010, C-20460, D-25996, D-29973, E-19849, F-23187, G-21125, K-07766, K-31516, L-32382

SUPERSATURATION B-29533, C-23106, F-07681

SURFACE COATING OPERATIONS A-32855, A-34585, B-03966, B-04533, B-06366, B-08506, B-09784, B-09791, B-09819, B-11137, B-14895, B-31301, B-31472, D-03431, L-07235

SURFACE COATINGS A-23843, A-32855, A-34585, B-02427, B-03966, B-06088, B-08506, B-09819, B-09830, B-16890, B-21294, B-26087, B-26125, B-27732, B-31301, B-31472, C-08066, C-11486, C-28393, D-02339, D-06535, D-09592, I-05463, L-00054

SURFACE PROPERTIES B-20625, B-30530, B-32070, C-10016, G-06323

SURVEY METHODS A-24350, B-31178, C-04117, C-11167, C-30374, D-00751, D-02331, D-03514, L-00871, M-00376, M-23408, M-27680

SUSPENDED PARTICULATES A-00402, A-02001, A-05007, A-05335, A-05527, A-06039, A-07394, A-07561, A-08373, A-08802, A-08912, A-09175, A-09853, A-10075, A-10699, A-11651, A-12083, A-12377, A-12505, A-14116, A-14914, A-14972, A-16058, A-17462, A-17634, A-20101, A-20125, A-20276, A-22860, A-23313, A-24007, A-24459, A-26048, A-26402, A-26575, A-26605, A-27129, A-27235, A-27249, A-27669, A-27821, A-27986, A-28614, A-28861, A-29353, A-30603, A-30687, A-31323, A-31759, A-32489, A-32653, A-33828, A-34018, A-34228, A-34290, A-34654, A-34891, A-35383, A-35564, A-35693, B-00025, B-00246, B-00257, B-00379, B-00504, B-00541, B-00975, B-01352, B-01537, B-01549, B-01613, B-01867, B-02047, B-02427, B-02725, B-03129, B-04361, B-04533, B-04664, B-04943, B-04949, B-05490, B-05532, B-05852, B-05929, B-05930, B-06088, B-06280, B-06366, B-06453, B-06525, B-06636, B-06979, B-07224, B-07429, B-07479, B-07971, B-08360, B-08497, B-08506, B-08663, B-08946, B-09608, B-09733, B-09784, B-09791, B-09794, B-09813, B-09815, B-09819, B-09827, B-09830, B-09836, B-09839, B-09840, B-09842, B-09849, B-09852, B-09857, B-10009, B-11008, B-11137, B-11220, B-11234, B-13551, B-14341, B-14609, B-14895, B-14951, B-14956, B-14967, B-16842, B-17906, B-18140, B-19218, B-19221, B-20120, B-20817, B-20877, B-20878, B-21006, B-21220, B-22435, B-22518, B-23008, B-23067, B-23493, B-23836, B-24065, B-24090, B-24380, B-24845, B-24969, B-24988, B-25017, B-25554, B-25694, B-26087, B-26308, B-26567, B-26568, B-26730, B-26731, B-26778, B-26908, B-26944, B-27541, B-27548, B-27793, B-27818, B-28146, B-29533, B-29761, B-30865, B-30943, B-31233, B-31400, B-31453, B-31456, B-31631, B-31700, B-31945, B-32634, B-32682, B-32781, B-32847, B-32913, B-32937, B-33077, B-33793, B-33854, B-34679, B-35554, B-35566, B-35955, C-03010, C-04117, C-05503, C-07214, C-11167, C-15287, C-20100, C-23107, C-29337, C-35956, D-00241, D-00251, D-00373, D-00690, D-00751, D-01202, D-03001, D-03017, D-03418, D-03431, D-03514, D-05481, D-09590, D-09592, D-12426, D-12648, D-18231, D-23411, D-23845, D-24162, D-25291, D-29973, D-31371, D-31760, D-35764, E-19849, E-26550, G-00177, I-24187, J-29299, K-00157, K-07766, K-15926, K-16263, K-18294, K-31286, K-31516, K-31968, K-35146, L-00973, L-01528, L-01604, L-02840, L-03198, L-04841, L-04888, L-04942, L-07235, L-07781, L-09215, L-09604, L-09677, L-10567, L-12376, L-14616, L-15554, L-15688, L-15691, L-19059, L-25446, L-27184, L-27185, L-27677, L-27678, L-27679, L-28363, L-29679, L-30149, L-30153, L-31084, L-32147, L-32171, L-32352, L-32382, L-34256, L-35694, M-01069

SWEDEN A-00393, A-01885, A-02001, A-03097, A-25205, A-30327, A-30389, B-00257, B-00358, B-00379, B-00504, B-00975, B-01352, B-01414, B-01505, B-01508, B-01563, B-01867, B-01900, B-02279, B-02427, B-02725, B-03499, B-03807, B-03966, B-03972, B-03976, B-04045, B-04300, B-04664, B-04666, B-04773, B-06280, B-08361, B-09656, B-09661, B-09933, B-11843, B-13334, B-17266, B-23456, B-25085, B-30339, C-03010, C-03542, C-07214, C-09953, C-09648, C-09657, C-10029, C-16080, C-21652, C-25466, C-29891, C-35949, D-00373, D-01202, D-01949, D-02331, F-01784, F-03173, G-00177, G-09659, K-18294, K-35146, L-02840, L-03198, M-15760, N-03438

SYNERGISM A-07089, A-26911, A-33719, B-06636, C-29243, G-05946, K-35146, L-34926

SYNTHETIC FIBERS A-10699, A-29599, B-03129, B-09813, B-27605, D-09590, L-01604

SYNTHETIC RUBBER A-03825, B-00032, B-14956, C-11486

T

TAR B-09836, C-35956, D-02339

TAXATION L-26511, L-35752

TEFLON C-09521, C-34863, D-00690, D-01949, M-01069

TEMPERATURE A-01644, A-01885, A-03825, A-04879, A-05549, A-07561, A-08359, A-08912, A-10699, A-20276, A-24007, A-24754, A-27235, A-28527, A-29599, A-30218, A-30687, A-31155, A-32489, A-34654, A-35383, B-01414, B-02725, B-03966, B-03976, B-04533, B-04950, B-04951, B-04952, B-04953, B-05808, B-05852, B-06088, B-06280, B-06366, B-07362, B-08361, B-08506, B-08663, B-09655, B-09791, B-09830, B-09836, B-11136, B-11137, B-11673, B-12346, B-12506, B-13697, B-19705, B-20625, B-20824, B-22538, B-23002, B-23117, B-23493, B-23967, B-24197, B-24969, B-25694, B-26002, B-26308, B-26731, B-26778, B-26944, B-27288, B-27674, B-27818, B-28047, B-28146, B-28206, B-29131, B-29251, B-29278, B-29533, B-29978, B-30738, B-30943, B-31072, B-31091, B-31167, B-31453, B-31911, B-32070, B-32119, B-32302, B-32497, B-32498, B-32559, B-32634, B-32847, B-32956, B-33073, B-33077, B-33122, B-33816, B-34778, C-03789, C-08355, C-08356, C-08357, C-08358, C-10693, C-20460, C-21208, C-25065, C-28787, C-32467, C-34972, C-35648, C-35956, D-07572, G-06323, I-19325, J-29299

TEMPERATURE (ATMOSPHERIC) A-29599, B-00358, B-09836, C-08678, C-26966, D-01202, D-06535, D-09590, D-09592, D-25996, D-31760, E-14906, G-06323, L-34256, N-03438, N-19088

TEMPERATURE SENSING INSTRUMENTS B-09791, C-35956, N-20495

TENNESSEE B-06636, L-02840, L-19059, L-32626, M-01069

TENSILE STRENGTH B-08361, I-05463

TEST ENGINES A-33564, A-33648, B-01867, B-11220, C-03542, D-00251, G-00177

TESTING FACILITIES A-03825, A-05007, A-06981, A-08359, A-33564, A-33648, A-35673, B-01867, B-11220, B-13398, B-25224, C-00965, C-03010, C-03542, C-08268, C-08357, C-09648, C-11123, C-12487, C-17290, C-17638, C-18194, C-23755, D-00251, D-18231, F-16455, G-00177, G-00715, G-09659, L-03198, L-04841, L-35511

TETRAETHYL LEAD A-24459, A-30603, B-28108

TEXAS B-01867, B-08364

TEXTILE MANUFACTURING A-17634, A-27235, A-34018, B-02047, B-26567, B-27605, B-31700, D-09590

TEXTILES A-10699, A-29599, B-03129, B-09813, B-09815, B-09830, B-09836, B-27605, B-31700, D-09590, I-05463, L-01604

THERMAL RADIATION A-25179, A-34654, B-24197, B-31790, C-35182, L-34033

THERMISTORS C-35956

THERMOCOUPLES C-35956

THERMODYNAMICS B-04953, B-29533, B-29978, F-07681, F-32271

THERMOMETERS C-35956

THIOPHENE B-04627, C-07214, C-33349

THRESHOLDS A-04785, A-07089, A-17631, A-19899, A-20118, A-21661, A-21857, A-31263, A-32878, B-02729, B-04627, B-04666, B-04669, B-09854, B-10005, B-27288, B-31233, C-06381, C-08066, C-08678, C-08953, C-09364, C-09521, C-09648, C-10693, C-10983, C-11123, C-14108, C-14109, C-16080, C-16540, C-17638, C-17640, C-18093, C-22448, C-22958, C-24071, C-24429, C-24814, C-25065, C-25466, C-26837, C-26966, C-27685, C-27733, C-27934, C-28141, C-29269, C-29891, C-30689, C-32676, C-32880, C-33349, C-35240, C-35956, D-00209, D-16635, D-20355, D-23098, D-31760, F-19063, F-35651, G-00177, G-03788, G-05942, G-05943, G-05946, G-05949, G-06323, G-07091, G-07821, G-09659, G-11476, G-19599, G-34667, G-34686, G-35570, G-35671, K-05947, K-11734, K-20194, K-21083, K-21084, K-21918, K-27403, K-30870, K-35146, M-15760, N-05235

TIMED FUEL INJECTION A-06039, A-08802, A-09255, A-12377, A-26048, A-27129, A-27249, A-30851, B-01613, B-06280, B-06525, B-08497, B-23067, B-31631, L-04888

TISSUES B-09854, C-34972

TITANIUM G-05942

TOBACCO D-09590, L-03198, N-03438

TOKYO A-30513, A-32855, B-20628, B-24380, B-32797, C-17678, D-29973, L-27185

TOLUENES A-05007, A-32855, B-04627, B-16498, C-07214, C-11123, C-14109, C-27934

TOPOGRAPHIC INTERACTIONS A-02765, A-11700, A-12832, A-12834, A-28352, A-29353, B-01672, B-02794, B-26087, C-08066, D-03017, D-06535, D-09592, D-23098, D-31371, D-33539, G-03788, K-16263, L-0067[illegible], L-02840

TOXIC TOLERANCES B-02427, G-07821, G-35570, K-11734, K-31968 K-35146

TOXICITY A-03825, A-17603, A-21661, A-30513, A-31759, A-32878, A-35581, B-09922, B-16890, C-35182, G-05942, G-05943, G-05946, G-05949, G-07821, G-11476, G-21125, G-23298, G-35570, K-05947, K-27403, K-35146

TRACE ANALYSIS C-20202, G-05949, N-20495

TRACERS C-05396, C-05813, C-27248, C-35956, L-04841

TRACHEA B-31400

TRADE ASSOCIATIONS B-34868, L-12376, L-14798

TRAINS A-08802, B-00975, B-06979, B-08497, B-14951, B-31400, L-00054

TRANSMISSOMETERS B-06280, C-32022

TRANSPORT A-33828, A-35693, C-22958, C-25065, D-23098, D-25780

TRANSPORTATION A-00393, A-01565, A-05007, A-05335, A-05527, A-05549, A-05608, A-06039, A-08802, A-09255, A-11692, A-12377, A-12505, A-12832, A-12834, A-14116, A-14297, A-14914, A-15297, A-16058, A-20101, A-20118, A-20125, A-20134, A-20553, A-20557, A-21700, A-22973, A-25327, A-25455, A-26048, A-27129, A-27249, A-27451, A-27986, A-28352, A-28614, A-30327, A-30603, A-30851, A-31323, A-31759, A-31882, A-32465, A-32653, A-33564, A-33648, A-33719, A-34018, A-34766, A-34891, A-34964, A-35590, A-35635, B-00504, B-00975, B-01613, B-01867, B-05490, B-06280, B-06453, B-06525, B-06636, B-06979, B-07224, B-07362, B-07479, B-07971, B-08497, B-08604, B-08663, B-09608, B-11220, B-11234, B-12133, B-14951, B-17906, B-20120, B-20877, B-20878, B-21220, B-23067, B-24845, B-24988, B-25594, B-25711, B-27719, B-28108, B-29437, B-29533, B-29628, B-30865, B-31167, B-31400, B-31631, B-33077, B-34778, C-02786, C-03542, C-05170, C-06112, C-07266, C-09620, C-11167, C-14606, C-14607, C-14680, C-16298, C-16442, C-16781, C-20100, C-21693, C-22448, C-26966, C-27121, C-27934, C-29337, C-31222, C-31924, D-00241, D-00251, D-00373, D-01202, D-01949, D-02331, D-03418, D-03431, D-03459, D-03506, D-09592, D-18231, D-24162, D-25291, D-27255, D-29973, D-33108, D-33539, G-21125, G-34667, K-00157, K-07766, K-16263, L-00054, L-03198, L-04841, L-04888, L-05129, L-07235, L-09215, L-09677, L-12376, L-19059, L-22343, L-27185, L-27677, L-32147, L-34926, L-35511, L-35694, M-23408, N-03438, N-19060, N-32254

TRAPPING (SAMPLING) A-04785, C-08355, C-08356, C-08358, C-09657, C-09860, C-10016, C-16781, C-24814, C-29726

TREATED FABRICS C-09619, G-00177

TREATMENT AND AIDS C-29858, D-27255, G-05942, G-06323, I-24187, L-30153, L-30688, L-34256

TREES A-19814, A-34018, B-09407, B-09655, B-22061, K-11734

TRIMETHYLBENZENE G-00177

TRUCKS A-05007, A-06039, A-08802, A-27129, A-27986, A-34891, B-00504, B-00975, B-01867, B-05490, B-06280, B-06525, B-06979, B-07224, B-07971, B-08604, B-09608, B-20120, B-20877, B-20878, K-00157, L-00054, L-03198, L-04841, L-04888, L-09215, L-19059, L-32147

TUNNELS B-31400

TURBIDIMETRY C-35956

TURBULENCE (ATMOSPHERIC) A-33828, B-04838, B-04949, C-08066, C-22958, E-14906, L-35511

U

ULTRASONICS B-08364, B-31631

ULTRAVIOLET RADIATION A-25179, B-01352, B-21006, B-27674, C-35182, G-00177

ULTRAVIOLET SPECTROMETRY A-03825, B-05408, B-05624, C-05426, C-20100, C-29337, C-29843, G-00177

UNDERFIRE AIR A-28861, B-10009

UNITED STATES A-34585, B-06280, B-10588, C-10593, K-11734, K-35146, L-30149, L-35694

UNIVERSITIES B-07971, B-08364, D-02212

UPPER ATMOSPHERE F-07681

URBAN AREAS A-16058, A-17198, A-22860, A-22973, A-24500, A-27669, A-28614, A-30513, A-31044, A-31263, A-31759, A-32465, A-32855, A-33828, A-34228, A-35693, B-00358, B-04361, B-08360, B-09608, B-20628, B-25479, B-26618, B-31178, B-31301, B-31354, B-32797, C-22431, C-35541, C-35949, D-00690, D-01949, D-02212, D-03459, D-03506, D-03514, D-05481, D-09590, D-12426, D-20355, D-23149, D-23152, D-23845, D-24162, D-25291, D-26304, D-27255, D-29349, D-29973, D-31371, D-33108, D-33539, D-33723, D-35764, G-00208, G-05942, G-05949, G-28175, G-34667, H-20028, K-05947, K-35146, L-00054, L-01604, L-02840, L-07235, L-09677, L-10567, L-26511, L-27184, L-27185, L-29813, L-30149, L-30153, L-30688, L-32171, L-32352, L-32354, L-34926, M-01069, M-14491, M-15760, M-23408, M-26725, M-30896, N-01539, N-32254

URINALYSIS A-02765, B-00975, B-02427, C-03354, D-00751, D-03017, D-27255, G-00177, L-03198, N-03438

USSR B-22400, B-29278, B-31072, C-11486, C-35182, D-05256, D-16635, D-16636, E-14906, G-05942, G-05943, G-05946, G-05949, G-11476, G-35671, K-05117, K-05947, K-20194, K-21083, K-21084, K-35146, N-05235

V

VALLEYS B-00975, B-01672, B-26176, B-27605, D-03514, D-09590, D-09592, L-00054

VANADIUM COMPOUNDS B-27401

VAPOR PRESSURE A-32411, B-04951, B-04952, B-04953, B-09655, B-09794, B-09836, B-16890, B-24065, B-32956,

C-08355, C-08356, C-08358, C-23106, G-06323
VAPOR RECOVERY SYSTEMS A-35599, B-01672, B-07362, B-08467, B-09656, B-09836, B-09840, B-09849, B-16747, B-16842, B-21647, B-22353, B-28118, B-31463, B-34385, D-07572, G-05942, L-32352
VAPORS A-09175, A-24527, A-32489, A-35599, B-04952, B-04953, B-05408, B-05409, B-05532, B-05624, B-05929, B-06088, B-06103, B-07362, B-08467, B-08946, B-09656, B-09794, B-09836, B-10005, B-12346, B-15709, B-15779, B-20369, B-23002, B-23117, B-25085, B-27288, B-28047, B-29363, B-29533, B-32847, B-33742, C-07214, C-09521, C-09620, C-09648, C-10016, C-10593, C-10693, C-14197, C-15287, C-35648, D-07572, D-09592, F-16455, F-19102, G-05942, G-05949, G-06323, I-05463, K-05947, K-20194, K-21083, K-21084, L-32382
VARNISHES A-23843, A-32855, B-02427, B-03966, B-06088, C-11486, I-05463
VEGETABLES C-08066, D-09590
VEHICLES A-01565, A-05007, A-05549, A-05608, A-06039, A-08802, A-12377, A-16058, A-26048, A-27129, A-27986, A-28352, A-28614, A-30327, A-30851, A-31323, A-31759, A-31882, A-32465, A-32653, A-33719, A-34018, A-34891, B-00504, B-00975, B-01867, B-05490, B-06280, B-06453, B-06525, B-06979, B-07224, B-07479, B-07971, B-08497, B-08604, B-08663, B-09608, B-11220, B-12133, B-14951, B-17906, B-20120, B-20877, B-20878, B-25594, B-25711, B-28108, B-31400, B-31631, B-33077, C-06112, C-09620, C-16298, C-22448, C-31222, D-02331, D-03431, D-03459, D-09592, D-24162, D-25291, D-27255, D-29973, D-33108, D-33539, K-00157, K-16263, L-00054, L-03198, L-04841, L-04888, L-07235, L-09215, L-12376, L-19059, L-22343, L-27185, L-27677, L-32147, L-34926, N-03438, N-19060, N-32254
VENTILATION A-04860, A-26605, A-30389, A-35599, B-00358, B-04666, B-05624, B-09813, B-09819, B-09854, B-09857, B-10005, B-13812, B-14951, B-20754, B-20824, B-21220, B-23456, B-23836, B-24810, B-27674, B-29761, B-30809, B-31233, C-10029, C-21208, D-00373, L-07235, L-29975
VENTURI SCRUBBERS A-00525, A-17634, B-00025, B-00571, B-01672, B-02047, B-02279, B-04227, B-04669, B-04773, B-04781, B-04783, B-04949, B-05332, B-05880, B-06859, B-07374, B-07415, B-07434, B-08360, B-09733, B-09849, B-10277, B-10588, B-11008, B-14094, B-15709, B-16842, B-20817, B-29251, B-30124, B-30530, B-31062, B-31472, B-32615, B-35595, B-35660, C-27791, D-09592, G-00177
VERMONT B-01672
VIRGINIA L-32626
VIRUSES B-06688
VISIBILITY A-03097, A-33828, A-34018, A-35693, B-00975, B-26087, D-01202, D-01949, D-03431, D-06535, D-09590, K-11734, L-00054, L-01604, L-02840, L-32171, L-32382, L-32383, L-33672, M-00376, M-00844, M-01069, M-26725
VISIBLE RADIATION G-11476
VOLATILITY A-01885, A-05608, A-08359, A-21978, A-33983, A-34290, A-34585, A-35622, B-08467, B-09656, B-09836, B-09840, B-09842, B-16890, B-25594, B-26731, B-31091, B-32956, C-03354, C-08355, C-35648, C-35865, C-35949
VOLCANOES A-09402
VOLTAGE B-06688, B-24065, B-25711, C-06526

W

WASHINGTON (STATE) A-32653, B-00552, B-08360, D-01949, D-06535, D-09592, L-00054, L-30149, M-00844
WASHINGTON D C L-09677
WATER A-09175, A-20276, A-27972, A-29455, B-06103, B-09794, B-09839, B-09842, B-15779, B-16365, B-25017, B-25224, B-29533, B-31091, C-28787, I-05463
WATER POLLUTION A-07089, A-12083, A-30389, A-31602, A-33883, B-01508, B-01549, B-06688, B-09839, B-09842, B-16535, B-22550, B-22837, B-23538, B-25085, B-27605, B-27719, B-27732, B-28118, B-30124, B-31794, B-32615, B-32900, B-32913, B-32935, C-32022, D-25291, D-31371, D-33108, D-33723, F-26529, G-03788, J-34518, L-14616, L-15691, L-17258, L-25446, L-27184, L-27185, L-27677, L-27678, L-27679, L-28348, L-28363, L-30153, L-34033, M-24091
WEATHER MODIFICATION L-32566
WEST AND GAEKE METHOD B-02279, C-30014, D-05481
WEST VIRGINIA A-02765, A-07089, B-06636, B-26087, D-03514, D-09590, D-25780, D-25996, L-09677, L-26940, L-32626
WET CYCLONES B-07415, B-09733, B-10588, B-15709, B-30530, B-35660, B-35803, C-03010, M-31071
WETTING B-09836
WIND ROSE B-01672, D-01202, D-02339, L-02840
WINDS A-03097, A-05007, A-06240, A-11700, A-20706, A-23313, A-24500, A-29353, A-29599, A-30513, A-35564, A-35693, B-00975, B-01508, B-01672, B-09836, B-16842, B-26087, B-32900, C-00178, C-08066, C-08678, C-09660, C-11167, D-00690, D-01202, D-01949, D-02331, D-02339, D-03017, D-03418, D-03431, D-03459, D-03506, D-03514, D-06535, D-09590, D-09592, D-12648, D-25996, D-27255, D-31371, D-31760, D-33108, D-33723, E-14906, L-00054, L-02840, L-07235, L-29813, M-00487, M-27680, N-03438
WISCONSIN L-00973
WOOD A-01644, A-01885, A-16494, A-30701, A-34228, A-34290, B-01352, B-09655, B-09784, B-09836, B-09840, B-31301, B-31472, C-09660, D-09592, N-03438
WOOLS B-09813

X

XYLENES A-05007, B-03966, C-11123

Y

YOKOHAMA L-27184, L-27185

Z

ZINC B-09784, D-09590
ZINC COMPOUNDS A-32489, B-04666, B-09839, C-09657, F-11132,

☆ U. S. GOVERNMENT PRINTING OFFICE: 1972—746763/4118